Dr. Jason Barnes:

Hey, there, welcome to another episode of ENT in a Nutshell. My name is Jason Barnes and today we're joined by Dr. Michael Gluth and we'll be discussing chronic ear disease. Dr. Gluth, thanks so much for being here.

Dr. Michael Gluth:

Glad to be here. Excited to chat.

Dr. Jason Barnes:

Typically when we have these episodes we start with the presentation. But as you and I kind of discussed already, it's probably better to define what we're even talking about here since this is a wide spectrum. So can you start by just explaining to us when we talk about chronic ear disease, what are we talking about?

Dr. Michael Gluth:

Yeah. So this is a curious topic because I think surgeons that take care of a lot of these patients often have a really clear grasp in their own mind of what this condition is, but it's a little more difficult to neatly verbalize what a chronic ear is in a succinct way that really captures the entire spectrum of what we're dealing with. So, in a simplistic way, often people would say, "Oh, well, a chronic ear is a chronic condition where you have a perforated eardrum, and you have chronic otorrhea." But unfortunately, that excludes a lot of relevant cases.

So take, for example, a patient that has major chronic eardrum retraction, underlying middle ear effusion, underlying ossicular erosion and then ultimately evolves into a cholesteatoma. Well, that patient doesn't have a perforation, and they may really not have prominent otorrhea. So that doesn't really work. Sometimes you'll hear people say chronic ear disease is just sort of the full spectrum of eustachian tube dysfunction, or eustachian tube dysfunction gone bad. And that allows for inclusion of the majority of cases but there's a lot of exceptions there too. So you'll see patients that may have traumatic perforation that turns into a chronic ear, or you may have a situation where there's something like a slag injury.

Also, there are situations where you'll evaluate a patient that has an irritated ear, or a mesotympanum at least, and the eustachian tube seems to be working well, but they'll have an isolated dysventilation of the attic and an attic cholesteatoma. And there may be nothing wrong with the eustachian tube in that situation. So the reality of this condition is that it is a spectrum of disease, where in you have a number of pathophysiologic processes that overlap with each other. And they variably present in a given ear. So understanding these variable pathologic processes or pathophysiologic processes are really the key in understanding what a chronic ear is.

Dr. Jason Barnes:

And when we talk about some of the terminology around how we talk about chronic ear disease, what are some things we should pay particularly close attention to?

Dr. Michael Gluth:

Yeah. So unfortunately there's been an alphabet soup of terminology used to describe some of these ears. And unfortunately, there's not a accepted classification system for chronic ear disease. Having said that, there are some accepted standards and I think we can go over some of these. And as we do so I

think that understanding the terminology also is relevant to the underlying pathophysiology that we're talking about.

So, the first thing I think to understand or to talk about is the spectrum of chronic middle ear disease in the setting of an intact eardrum. So, Bluestone is sort of the individual who classified chronic middle ear disease with an intact eardrum as being either eustachian tube dysfunction, otitis media with effusion, or acute otitis media. So understanding these three and what's going on I think is an important or a good place to start.

So eustachian tube dysfunction, of course, we're talking about a dysventilation syndrome of the tympanomastoid space where there's a derangement in the homeostatic mechanism of gas exchange and pressure equalization in the middle ear space. So these patients have negative middle ear pressure, they'll present with discomfort, fullness, may have some mild hearing loss, may have a little bit of eardrum retraction, but they don't have an effusion. And so, the next classification being otitis media with effusion is I think one of those conditions where the alphabet soup comes in. So, people have in the literature variably called this serous otitis media or secretory otitis media. But really what we're looking at here is a dysventilation syndrome where patients develop an exudative middle ear fusion. But more than that, it's when they start to develop some distinct changes in the mucosa.

So if you look at these patients from histopathologic perspective, they start to develop mucosal edema with widening of the sub epithelial space. As it progresses you may see some inflammatory cell infiltration into the mucosa with cytokine release. You can see loss of ciliary function. Most of the prominent cilia bearing cells in the middle ear, in the protympanum area around the tubal orifice and so you'll see loss of cilia. And then over time you'll start to see a goblet cell predominance. And when that happens, perhaps the effusion will develop more of a mucinous component where you have a glue ear type situation.

And so there are some ears that will be chronic and really just fall within the eustachian tube dysfunction or otitis media with effusion spectrum with progressive eardrum collapse and atelectasis, and eventual cholesteatoma formation but not necessarily have a prominent infectious component. So the third type of middle ear disease with an intact eardrum is reserved for those ears that break bad, if you will. And so we're looking at a situation where a patient has a middle ear effusion but then rapidly develops pain and systemic symptoms such as fever, irritability. And there are four stages classically described to understand acute otitis media.

So you start out with inoculation in the so called hyperemic phase, you move on to a second exudative phase where there's cytokine mediated capillary leakage. And then ultimately you have a suppurative phase where you have pyogenic process usually neutrophil driven which unfolds. This is a key phase because this is often when we would see a tympanic membrane perforation and infectious otorrhea. And then usually you move into a resolution phase where the infection and inflammation progressively subsides and hopefully you have healing. Some of these ears will revert to otitis media with effusion or eustachian tube dysfunction. But in a percentage, the perforation can persist and devitalize and then those are the ears that move on to become what we call chronic suppurative otitis media.

So when we look at chronic conditions in medicine, strictly speaking we're talking about something that's been present for three months. But with chronic ear disease, usually this has been present much longer. So we've tried to classify this according to things like the eardrum integrity, the otorrhea frequency or severity, whether or not there's cholesteatoma present or not, what are the sub areas of the ear that's involved so that some people use words like tubotympanic chronic otitis media when you have prominent pars tensa disease and eustachian tube dysfunction versus atticoantral chronic otitis media where you have epitympanic disease and cholesteatoma, selectively in that ear. So

it does get quite confusing. But in the end to summarize what we're talking about, I think chronic ear disease is essentially a chronic inflammatory condition affecting the middle ear space, lasts at least three months, but usually longer. And there's a spectrum that's generally associated with one or more of the following among dysventilation of some sort of the tympanomastoid space. Eardrum abnormalities either a perforation or retraction, middle ear remodeling including mucosal disease, ossicular dysfunction and scar sequela.

Perhaps some type of infection including a unique micro biologic snapshot that we see in these chronic ears which we can talk about later. Conductive hearing loss, and then the possibility of associated cholesteatoma or associated complication.

Dr. Jason Barnes:

So when we're talking about chronic ear disease, we've alluded to this, but who's the typical patient who presents to your clinic with chronic ear disease and how do you evaluate them?

Dr. Michael Gluth:

Yeah, so you can see this in either adults or children. To be honest there's limited data available regarding the exact risk factors for chronic ear disease, but we infer that the risk factors known for acute otitis media also apply to the chronic condition. So with that we're talking about things like age or eustachian tube maturity. Certainly a past history of severe acute otitis media puts you at risk for chronic ear disease, craniofacial abnormalities, or cleft palate. Patients that have had radiation to the temporal bone, immunodeficiency, social factors such as poor hygiene or poor living conditions and malnutrition. And then there have been certain ethnic groups in particular the indigenous people of Australia, Alaska, the southwestern United States, or Greenland, which seem to be particularly at risk.

Dr. Jason Barnes:

And what are the some of the symptoms folks are complaining of when they present to your clinic?

Dr. Michael Gluth:

Right, so as I've alluded to, there's a broad spectrum of underlying disease. So there's variability in how these patients present. So when you think of chronic ear disease, I think it's fair to start by thinking about someone who comes in with hearing loss and chronic otorrhea, but they may have things like fullness, pressure, pain, itching, tinnitus is pretty common. Some patients complain of headache. And then there's other symptoms such as vertigo, facial weakness, or a history of neurologic complications like seizures that have been unexplained, meningitis or mental status changes which might suggest a complication.

Dr. Jason Barnes:

And what are you looking for on physical exam?

Dr. Michael Gluth:

Right. So first and foremost, you perform a microscopic ear examination with attention to the ear canal and tympanic membrane. So what's the status of the eardrum? Is there a perforation? Often you'll see otic pus, if there is a perforation in the middle ear because this disease looking off at edematous maybe granulating. Some of these patients with granulation will bleed from time to time, and so there may be a

blood tinge component to the otorrhea which is always alarming to patients. Alternatively, the eardrum may be retracted either the pars tensa or pars flaccida even to the point of complete drum collapse.

In those patients there may or may not be an underlying middle ear effusion. Commonly you'll see chronic scar sequela. So myringosclerosis involving the eardrum or if you can see through a perforation. In severe ear sometimes you'll see tympanosclerosis plaques in the middle ear space. One clinical pearl is related to an aural polyp. So if you look in the ear and you see an aural polyp, you need to be thinking about cholesteatoma. Keratin is highly immunogenic and so cholesteatoma often reacts with mucosa to generate a polyp. And so that's a clinical pearl. Sometimes you'll see a retrotympanic whitish cyst, or eroded ear canal bone. Some of these patients will have secondary fungal infections. So you'll see fungal spores. And then you also look for stigmata of past surgery. So an extruded tympanostomy to postauricular scar, mastoid cavity or evidence of previous eardrum grafting.

Dr. Jason Barnes:

And when patients present with some of these more classic symptoms, tympanic membrane perforation otorrhea, what is your differential diagnosis?

Dr. Michael Gluth:

Yeah, so I mean, you're thinking about like we said, the spectrum of eustachian tube dysfunction, but there are other disease conditions which are relevant that you need to be thinking about. So things like systemic vasculitis, so sarcoidosis, granulomatosis with polyangiitis, Churg-Strauss disease, you may want to think about some type of immunodeficiency, especially immunoglobulin subclass deficiency, or even HIV infection. Some of the ciliary diseases, so ciliary dyskinesia or perhaps even cystic fibrosis, although of course those patients are going to have a lot of rhinologic disease. And then I think you also need to think about the possibility of some type of neoplasm. So, middle ear tumors such as papilloma or paraganglioma. Malignant tumors, so squamous cell carcinoma, adenoid cystic carcinoma, or even something unusual like Langerhans cell histiocytosis. So, if you have refractory chronic ear and you see something unusual in the middle ear space, you should have a low threshold for biopsy.

Dr. Jason Barnes:

And moving on to kind of the workup. What is your next step in these patients and how do you break down the different aspects of what you're looking for when you're evaluating someone with a chronic ear?

Dr. Michael Gluth:

So you take a comprehensive history and you examine the ear, as we already discussed, you don't want to neglect examination of the nose and nasal pharynx, to see carefully what's going on there. Most all of these patients at some point are going to have an audiogram, including a tympanogram, and some of them may undergo radiologic imaging. So specifically, CT scan without contrast of the temporal bone would be most common.

I will say CT imaging in these patients is controversial. So some people have a low threshold for imaging, others are a little more hesitant. I think certain situations makes a little more sense than others. So if you suspect a cholesteatoma and you're planning on operating on the patient, the patient has had extensive past surgery, if there's some type of a cranial facial syndrome where there may be an anatomic abnormality, especially with the facial nerve. If the patient has a complication present, or you're suspecting that, if you're worried about a neoplasm, or if you just have an ear that's been

refractory to significant past treatment efforts and you want to know a little bit more about what's going on.

So the idea is you do all these things, you examine the patient, you talk about what's going on, you image them, you test their hearing, and while you're doing that you're thinking about all of these pathologic processes that we just talked about. And I think it's critical while you're doing this to systematically assess the patient for the key aspects of chronic ear disease. And so in my practice there's really eight things that I'm thinking about while I'm doing that. I'm thinking about ventilation status, that eardrum status, the middle ear status, the infection status, the anatomic temporal bone status, the hearing status, whether or not there's a cholesteatoma and whether or not there's a complication.

Dr. Jason Barnes:

And going through this systematically, how do you assess ventilation?

Dr. Michael Gluth:

Yeah. So the first thing about dysventilation or eustachian tube dysfunction is that you want to get a sense of whether or not this is pervasive or something that's intermittent. So, for example, someone who has a cranial facial abnormality or has a radiated ear, that eustachian tube is probably never working. On the other hand, you'll have other patients who have seasonal allergic rhinitis, or maybe they do fine most of the time, but if they have an upper respiratory tract infection or get on an airplane, then they have a hard time recovering. So getting an idea of the timing and pervasiveness I think is important.

It's always a bit of a trick to definitively determine whether the eustachian tube is working, but there are an array of tricks and tools that we have. So often we'll have patient try to perform a Valsalva maneuver while we're examining them, or there's also what's called Toynbee maneuver where you have the patient pinch their nose, close their lips and swallow. You can perform pneumatic otoscopy, we perform tympanograms. It's useful to look in the contralateral ears. So a normal contralateral ear is certainly a good prognostic factor. We consider age. So roughly around age eight is when we think Eustachian tube should have anatomic and physiologic maturity. And then if you have a collapsed eardrum or a severe retraction, looking at whether or not there's any air in the protympanum I think is useful.

Some of these eardrums will have collapsed and scarred to the middle ear wall. Eustachian tube function recovers but the eardrum remains retracted. So whether there's a protympanic air collection or not, I think is helpful. And then you're also thinking about what parts of the tympanomastoid space are involved. So, if it's true Eustachian tube dysfunction, then you would expect all sub sites to be involved. But there is a condition or a situation that we call selective epitympanic and mastoid dysventilation where the connection between the attic and the rest of the middle ear space is blocked. And the rest of the middle ear space of course, is where the Eustachian tube connects to. So you can have a situation where there's dysventilation and negative pressure in the attic and therefore the mastoid while the rest of the middle ear is spared.

The connection or partition between the attic and the other parts of the middle ear called the epitympanic diaphragm and those are made up of the ossicles, mucosal folds, and ligaments. There are some reliable ventilation pathways adjacent to the staples that we call the tympanic isthmus, but those can be blocked with scarring, webbing, granulation, et cetera. And so considering which parts of the tympanomastoid space are just ventilated I think is important.

And then we move on to causes of Eustachian tube dysfunction. So rhinologic disease, allergy, what's going on with the adenoid? Is it hypertrophied? Is it the nasopharyngitis? Neuromuscular disease

such as myasthenia gravis can affect tubal function. Is the patient a smoker? Has there been radiation? Could there be something like a parapharyngeal or nasopharyngeal mass which is causing a mass effect? Is there a cleft palate or a cranial facial syndrome? And then there's also a rare situation where patient in fact has a patulous Eustachian tube, where they get into this cycle of habitual Valsalva. And that can lead to thinning of the eardrum, hypermobility, collapse, perforation. So that's also something I think we're thinking about.

So assessing ventilation then affects how we're going to treat the patient with medications, whether they need a tube, or some type of procedure like a balloon, Eustachian tube, tuboplasty. How we're going to deal with the eardrum, what materials we might use in grafting. Do we need to explore the middle ear and try to open up those ventilation pathways or do they need referral to a rheumatologist or immunologist or something like that?

Dr. Jason Barnes:

And continuing on through this systematic process? How do you evaluate the tympanic membrane?

Dr. Michael Gluth:

Right. So obviously a chronic perforation usually has these sort of thick and mature devitalized margins. And so obviously, how easy is it to inspect the eardrum in the office, and that gives you some idea as to how you might access it surgically. Which segments of the eardrum or disease. If it's retracted, then what happens is that the middle layer of the eardrum is deficient. So there's loss of collagen. And sometimes people call this a monomeric tympanic membrane, that's actually a misnomer. It's actually a dimer, where all you have is epithelium and mucosa and the cartilaginous supportive middle layer is absent.

So you'll see these patients often there's concerned when the pars tensa collapses posteriorly and starts to involve the ossicular chain or retracts down into the retrotympanum or onto the promontory. You also look at the pars flaccida. And that can be retracted as well onto the malleus neck or start to emerge into a cholesteatoma. I think it's really useful to be aware of some of the grading scales. There's a Tos and Sadé grading scale for pars flaccida and pars tensa retractions, if you're going to follow these over time in the office, objectively documenting how retracted these sub sites were helps you long term.

Moving on, after you assess the tympanic membrane then you consider the middle ear. So what's going on with the mucosa? Is it granulating? Is it fibrotic? In very severely diseased ears, there's this condition that we call chronic fibrocystic sclerosis where the middle ear space basically gets replaced by this thickened rind of fibrocystic scar tissue. And that really should be recognized as in stage middle ear disease and your prognosis for functional tympano ossicular reconstruction in an ear like that would be very poor.

So you wonder about whether or not there's post obstructive change or fusion. I will say there is a subgroup of patients that you'll see, a small subgroup who have extremely thick tenacious middle ear secretions, often like what you would see when performing sinus surgery. So these really rubber band like brownish type mucoid material. And that is a trigger to consider a condition that we call eosinophilic otitis media. I can tell you that's a real challenge to care for those patients. Because what's going on there is a disease process of the mucosa. And so doing things like placing a tube, or trying to treat these patients with ototopicals, usually is inadequate. And there's probably going to be a role for treating these patients with biologic agents like we do for patients that have rhinosinusitis. And in fact, a lot of these patients will also have nasal polyps or aspirin sensitivity.

So continuing on with the middle ear, we also look for new bone formation tympanosclerosis. On a chronic basis these thick calcified plaques can build up and that's also an extremely poor prognostic factor for functional reconstruction. You can remove plaques or do things to mobilize fixed ossicles, but the plaques have a tendency to want to come back. And then of course, what's going on with the ossicular chain. So any of the ossicles can be affected. Incus is most common. So the most common defect that we see in chronic ear disease is erosion of the incus long process. That said, the incus head can be fixed as well.

The second most common thing that we see is erosion of the stapes superstructure. The footplate can be fixed in cases if you have severe tympanosclerosis. The malleus very rarely eroded. Sometimes the manubrium can be foreshortened or eroded. If the malleus is diseased, it's more often fixation within the attic. So fibrosis or tympanosclerosis basically fuse the malleus head to the attic walls. So when you're considering treatment planning, this helps you get an idea of the prognosis for ossiculoplasty or tympanoplasty. Whether or not you want to perform a same stage or a stage ossicular reconstruction. If the middle ear envelope is severely diseased, you may want to let it calm down first. And it may even affect something like what type of packing you want to use for tympanoplasty. So, gel foam which is classically used is criticized for being pro inflammatory. In a really denuded, granulating middle ear space, you may consider something like hyaluronic acid packing which may reduce scarring.

So the next area is of course infection and there's a unique snapshot of the infectious profile that we see in chronic ear disease. Classically we think about Pseudomonas as being most common but certainly there's a variety of pathogens. MRSA is definitely an emerging major player, MSSA. And then other aerobic bacteria, you'll see enterococcus, Klebsiella, E. coli. So you can't just assume there's a Pseudomonas. For treatment, refractory cases obtaining culture is useful. Some studies have shown that up to 50% of cases have an anaerobic component. So peptostreptococcus in particular, or bacteroides species. Some may have a component of yeast especially Aspergillus or Candida species. And a lot of these infections are polymicrobial.

Certainly biofilms play a role in chronic otitis media. And so being familiar with the biofilm cycle and the role it plays and drug resistance and treatment resistance is important. So, doing some type of irrigation or surgical debridement may be what is necessary to break that biofilm cycle. Emerging research, especially on Pseudomonas has shown that they have a tendency to have colonies of sleeper cells basically, or dormant cells, which are genetically and metabolically inactive. So you can treat patients with antibiotics, there seem to be a clinical response. And then later those cells will basically wake up. There's also this idea that you can overwhelm ear infections with ototopical drug concentration.

So for example, when you culture an ear and you run a resistance profile, the resistance profile that they give you is based on presumed oral or systemic therapy. But the drug concentrations that you get without ototopical are often a thousand fold higher than that. So usually we think that ototopical treatment can overwhelm resistance. And that's usually true, but there's also emerging data to show that there are some highly resistant strains that are resistant at the concentration of what we would expect with ototopical therapy.

And when you're thinking about infection, there's also some rare pathogens. So mycobacteria or tuberculous otitis media is one of those that if you never consider it, you'll probably never diagnose it. So, those are going to be patients that are going to be at risk for mycobacterial infection based on exposure or social history. And those patients have large perforations. Some people describe them in some instances as being multiple or especially marginal perforations. And they very are early known to erode the ossicular chain, especially the incus. As we know, mycobacteria is difficult to culture and so

you have to have an index of suspicion and refractory or at risk cases to look for that and then put patients on prolonged treatment.

So understanding the unique infection in chronic otitis media, the sites involved, whether or not your ototopical therapy is going to get there? What are the pathogens? All sort of is important and treatment planning. In cases where you're planning surgery, then the next thing that we think about is the temporal bone status. So, what's the air cell pneumatization pattern in the ear? And this will probably only be evident if you get a CT scan, but is the temporal bone sclerotic or is it well pneumatized? Might there be congenital abnormalities with formation or development of the ossicles or the course of the facial nerve? What's the caliber of the ear canal? And what are the implications there for trying to remove cholesteatoma or trying to repair the eardrum? And then of course, what is the status of the mastoid with respect to disease? So of course, the mastoid air cell system is continuous with the middle ear. And so, many of these cases can properly be considered otomastoiditis. And so what do we need to do to apply treatment to those areas?

Also, in terms of safety, we think about things like height, or positioning of the [inaudible 00:31:04], or the positioning of the sigmoid and sometimes that also will help us plan a surgical approach. The other thing we assess of course is hearing, so I already mentioned that most of these patients will get audiograms. And classically you think of these patients presenting with a conductive or a mixed hearing loss. Tympanograms can be abnormal or normal depending on what's going on. So, type A, C or B to tympanograms are possible depending on the underlying pathology.

A few pearls I think that are useful in reading an audiogram in a chronic ear. First thing I would say is that if the eardrum is intact and the patient has greater than about a 30 decibel airborne gap, you should be suspicious for some type of ossicular pathology. If you look at that conductive hearing loss and it is selectively present just in the low tones, that's indicative of stiffness loading, and usually that implies tympanosclerotic or scar fixation of the incus and or malleus head within the attic. So upsloping conductive loss or selective low tone conductive hearing loss, think lateral chain fixation in the attic. If you see a greater than 30 decibel airborne gap and the airborne gap involved involves 2000 hertz, so 2K is not close, then most likely you'd be thinking about some type of ossicular erosion. And as we already said, incus erosion far and away is going to be the most common thing.

So we also consider the inner ear status. So inner ear status helps us prognosticate whether or not we might have a successful tympano ossicular reconstruction, or whether or not the patient's going to need a hearing aid or not. So, you know the patient's going to need a hearing aid that that might affect whether or not you're going to perform, say for example, a wall up versus a wall down mastoid procedure. If there's a major sensorineural component to the hearing loss that some of these patients go on to have the ear obliterated and the ear canal closed as a blind sack and later go on to get a cochlear implant, or if the middle ear space is just severely diseased and the prognosis for tympano ossicular reconstruction is poor, and the patient has failed multiple prior attempts at surgery, then in some of those cases you may think about closing the ear and placing something like a bone conduction hearing aid.

So the other thing that of course we think about is cholesteatoma. And I'm not going to get too far into the details of cholesteatoma because there's plans for a second podcast on that. But of course cholesteatoma is an indication for surgery and also greatly heightens the risk of a complication. So, we assess for congenital versus acquired cholesteatoma. Is it a retraction pocket versus a non retraction pocket cholesteatoma? If it's a retraction pocket cholesteatoma, where is it? Is it pars flaccida or pars tensa? Non retraction pocket would be something like epithelial growth around a perforation, which may be reason for [inaudible 00:34:21] and penoplasty failure or something like implantation or iatrogenic cholesteatoma from a past tympanostomy tube or something like that.

And then of course, the last thing is whether or not there's a complication. And of course, if there are intertemporal or intracranial complications, which I'm not going to go over right now is that I think also is a whole separate topic, then the urgency or emergency of the whole situation is shifted. So that often involves in patient care, systemic therapy, and sometimes surgical [inaudible 00:34:56].

Dr. Jason Barnes:

So next we'll move on to management strategies and I feel that one of the difficult things as a resident is to decide when to pursue which type of treatment. So we've discussed the systematic list of ventilation, tympanic membrane, assessment of the middle ear, infection, hearing status, temporal bone status, cholesteatoma, and other kinds of complications. How do you take all of these together and decide what's best for the patient next?

Dr. Michael Gluth:

Right. So in an ear that's not actively involved with a complication, then the general paradigm is to start with medical therapy, which is usually office based. So what we're trying to do is dry the ear or stabilize the ear first before ideally moving on with any type of surgery that might be necessary later. So office care involves aggressive aural toilets, so suctioning of secretions or debris, applying some type of medication, usually an ear drop or occasionally some type of a powder. If they're stick secretions, some people will apply some type of acidifying aural irrigation to clear secretions and clear a pathway for drops or powder. Drops or powders usually have some type of an antimicrobial component. Possibly a corticosteroid, possibly an acidifying agent, far and away at least in the United States, the fluoroquinolones containing drops are the mainstay of treatment because they're the only ones that have been FDA approved for application when you have a tympanostomy tube or a tympanic membrane perforation.

Having said that, the risk of ototoxicity in a acutely inflamed middle ear space, where they're sticking around the round window, there's probably not a real high risk of ototoxicity. But off label use of other drops is probably best reserved for cases where you have a good reason to do so. So if you manage these patients in the office, and it responds to treatments, and the ear is generally dry, and there's no sign of cholesteatoma, then in some cases that's good enough. So in other words, surgery is not mandatory in those cases and the risk of developing a complication later is low.

Now, having said that, some of those patients that dry up will still go on to have surgery for quality of life reasons. So if you want to try to restore their hearing, you want to facilitate the use of a hearing aid, or maybe there's some lifestyle consideration like the patient is a swimmer, and so you think about these things and so some of the low risk dry years will still be operated on but it's not mandatory. For those cases that you've tried to care for in the office but they still have chronic otorrhea or maybe the response is temporary and then they start to drain again, then those are the patients where you move on to surgery. And you're trying, of course to dry the ear, prevent future complications and so forth. So in summary, surgery is generally applied for those patients that have complications, cholesteatoma, medically refractory disease, or medically responsive cases where you need to do something to improve quality of life.

Dr. Jason Barnes:

And especially with patients who have a tympanic membrane perforation and are still draining, how do you decide whether or not to do a mastoidectomy and how to approach the tympanoplasty?

Dr. Michael Gluth:

So that's a great question. So far and away, the mainstay of treatment for chronic otitis media is to tympanoplasty. So, repair of the eardrum to restore that barrier separation between the moist mucoserous middle ear space, and the dry ear canal. And so tympanoplasty alone is sufficient in the overwhelming majority of cases. And so this is something that has been studied reasonably well with prospective trials. And there have been numerous systematic literature reviews on this topic, where uncomplicated cases of chronic ear disease with a perforation, even those that drain from time to time, do know better with tympanoplasty alone versus tympanoplasty plus mastoidectomy.

So the decision to apply mastoidectomy is really made on the specific cases where you have truly treatment refractory disease. Maybe on the CT scan, you see signs of osteitis. Maybe you're dealing with a case where there's a drug resistant pathogen. So, the real severe cases there probably is a role for mastoidectomy. But those are definitely exceptions. And the literature is pretty clear that routine therapeutic mastoidectomy has a very limited role.

Dr. Jason Barnes:

And one thing that I think is difficult as a resident to understand is, why does tympanoplasty do the trick when there's some sort of other underlying etiology?

Dr. Michael Gluth:

Well, tympanoplasty alone will not do the trick, I think, if you've not considered the other factors. So if you're not treating tubal dysfunction, if you're not dealing with some of these systemic things that lead patients to disease recidivism, you may repair the eardrum, stop otorrhea but patient will not ventilate and they may continue to retract, they may redevelop effusion. So, so you have to be again taking a holistic approach to this. That said, a lot of the techniques that have evolved to deal with tympanoplasty and the chronic ear setting are aimed at not only repairing the eardrum but augmenting it. So cartilage tympanoplasty provides very robust repair where the eardrum is then resistant to future retraction pocket formation or possibly future perforation.

Dr. Jason Barnes:

And how do you address Eustachian tube dysfunction in your treatment algorithm?

Dr. Michael Gluth:

Right. So in addition to all of the medical things that we've talked about, you need to be thinking about whether the patient needs and adenoidectomy. Some of these patients simply need a tympanostomy tube if you think it's going to be necessary long term than something like a T-tube. There are techniques where you can perform concurrent eardrum grafting with an intubated cartilage graft, especially using a T-tube and often those will stay in place for many years. And then of course there's a emerging but yet unclear role for things like Eustachian tube, balloon dilation, which also seems to improve Eustachian tube dysfunction in a subgroup of patients.

Dr. Jason Barnes:

And what's your approach to tympanoplasty? I know we talked about it a bit already.

Dr. Michael Gluth:

There's a lot of ways to approach tympanoplasty and I don't think it's useful to be dogmatic about it. So these procedures can be done either with an endoscope or a microscope. And there's relative

advantages to each. The endoscope gives fantastic visualization but requires you to work with one hand. Microscope requires line of sight visualization, but allows you to work with both hands. So you can do these procedures through the ear canal, either with an endoscope or a microscope using a speculum. It's also possible to apply a very limited endaural releasing incision, which allows you to get retractors into the external meatus which may help with trans canal surgery.

That said, the workhorse traditionally has been a postauricular approach. Postauricular approach can also be augmented with some type of a canalplasty procedure which improves visualization of the tympanic membrane. So there's a number of techniques described, all of which involve grafting of the eardrum, trying to restore integrity. There's classically an underlay procedure where a graft of some sort either fascia, or perichondrium, or cartilage is placed underneath the perforation and supported with packing. There are overlay techniques where you remove all of the remnant epithelium off of the eardrum, leave what's left of the fibrous layer and then apply some type of graph directly on to that. And then for smaller perforations, there are inlay graphs which are usually some type of a butterfly like cartilage insert, which you can splay into the eardrum, support with some packing and those might work in some cases as well.

Traditionally, fascia has been the most common material used to replace the eardrum, but cartilage has definitely emerged as also workhorse material. Obviously, cartilage provides rigidity. It is very viable even in actively infected ears. So very rarely dies or becomes infected. Traditionally people thought that grafting the eardrum with cartilage was a bad idea for hearing reasons, but the literature is pretty clear that at least in chronic ear disease, the hearing outcomes with cartilage and fascia are pretty equivalent. So, although fascia may theoretically may seem better because it's thin and it's pliable, it also has a tendency to form adhesions, especially on the under surface and cartilage may be a little bit more resistant to that. So you have to think about, how is your graft performing not only from its biologic properties, but how does it actually heal in a living system? So, yeah, those are the principles of tympanoplasty.

Dr. Jason Barnes:

And then how do you approach the ossicles in determining whether or not and how to fix those?

Dr. Michael Gluth:

So ossicular repair can range from simple bone summit repair of an eroded incostapedial joint to something like incus replacement using a synthetic prosthesis or an autograft. So if you're just replacing the incus that we call that a minor columelar repair or partial ossicular replacement. So a prosthesis for that would be a PORP. If you're doing a replacement of the incus and the stapes superstructure, then that would be a total repair or a tour. There is some controversy as to whether or not it's a good idea to reconstruct the ossicular chain at the same time as to tympanic membrane repair or whether it should be done in stages.

Results are probably better for two stage repair in cases where you're repairing the eardrum and the middle ear envelope is severely diseased. So allowing the middle ear envelope to heal and then coming back later and reconstructing is probably ideal. Having said that, there are a lot of surgeons that do single stage repair in every case, and then go back and revise the cases where it doesn't work very well. Rarely we'll encounter stapes fixation. And that's a very delicate topic. So the take home message there is basically don't touch the stapes footplate unless the eardrum has been repaired and the middle ear space has been stable and quiescent for a very long time.

Dr. Jason Barnes:

And you've alluded to ear canal closure or subtotal petrosectomy, can you give us some pearls on when you consider that?

Dr. Michael Gluth:

Yeah. So an example of a patient would be, take someone who's had radiation to the temporal bone, they have chronic otorrhea, they've had past attempts at tympanoplasty, and the grafts fail, maybe you look in the ear and there's peri otorrhea, there's exposed bone. So continuing on the pathway of trying to graft this ear over and over again is probably a bad idea. You may have another patient where they have a severe mixed hearing loss, and you know that that patient is not going to do well either with a reconstructive procedure or a hearing aid. In those cases you have to ask, what is to gain by trying to graft the eardrum if it has no functional use.

So in those cases often we perform what's called a subtotal petrosectomy. Really what that is is a radical mastoidectomy procedure. So that means that you remove all of the ear canal skin, you revert the lateral ear canal skin and oversaw it, you remove the eardrum, you remove the ossicles, and then you drill out all of the pneumatise portion of the temporal bones so far as possible. Some people will plug the Eustachian tube at the same time so that you're basically separating the middle ear and mastoid from the nasal pharynx, and then allow it to heal. And once those ears heal some of them later on will be candidates for some type of a hearing implant. But even the ones that aren't, you've eliminated the need for further surveillance, you've probably gotten rid of the otorrhea. So you've allowed the patients to do things like swim or get the ear wet.

So if you're going to go on and perform a major eardrum repair or revision eardrum repair in an ear that has no good functional hearing prognosis, then it's useful to step back and think maybe over closure and subtotal petrosectomy as a better pathway.

Dr. Jason Barnes:

So we've discussed the surgical and treatment options. How do you generally counsel patients on success rates and complications and how do you follow up with them?

Dr. Michael Gluth:

Yeah. So we call this chronic ear disease for a reason. So you have to follow these patients long term because recidivism is common. So patient may look great six months out or one year out, but as you gain experience in this you'll realize that delayed failures are not unheard of. So even in the best case I'm seeing these patients at least on a yearly basis for ear cleaning, examination, audiogram, that sort of thing.

As far as prognosis goes, that is going to vary wildly based on their prognostic factors. So things like, what is the status of the middle ear mucosa? Is there a lot of scar sequela? What's the Eustachian tube function or ventilation status? Are there underlying systemic diseases? So you take all of those into account to gain expectations. In the best case, very mildly affected ear, then it's possible to reconstruct these ears with an airborne gap under 10 decibels in the very best case, or under 20 in, I would say two thirds of patients. If you're just performing simple tympanic membrane repair where you think that the Eustachian tube function is reasonable, then I would expect closure of the air bone gap to 10 decibels or less in the overwhelming majority of cases. Looking at the percentage of cases where you successfully repair the eardrum and then the middle ear goes on later to have ventilation problems, the best estimate is that that's about one in five cases. So again, that's a significant percentage of patients. And so you need long term follow up.

Dr. Jason Barnes:

Well, this has been an awesome discussion for a topic that is pretty complex and I think, especially from the resident side, difficult to understand. So I really appreciate your time. Before I move into a summary, is there anything you'd like to add?

Dr. Michael Gluth:

No, I think that's it.

Dr. Jason Barnes:

So in summary, chronic middle ear disease is multifaceted, but patients often present with otorrhea and a tympanic membrane perforation. But as we discussed, there's a whole spectrum of this including Eustachian tube dysfunction, otitis media with effusion, and other aspects of chronic ear disease. And when we think about evaluating these patients, there are some key aspects that include what are the ventilation in the ear? What's the status of the tympanic membrane? What's the status of the middle ear? Is there infection? What's the status of the temporal bone? How is the patient's hearing? And is there cholesteatoma or other complications?

And when we consider management strategies, we can start out within office procedures to include drops and powders and aggressive aural toilet, but might need to move on to surgical management, including tympanoplasty, possible mastoidectomy, ossiculoplasty. And in some cases, subtotal petrosectomy with the ear canal closure. And as Dr. Gluth said, this is a chronic condition that might require quite a bit of follow up depending on the patient's severity.

Dr. Gluth, thanks so much. Is there anything you'd like to add?

Dr. Michael Gluth:

No, my pleasure. It's been great and I appreciate you letting me come on and talk about chronic ear disease.

Dr. Jason Barnes:

So we'll move on to the question portion asking of our time. As a reminder, I'll ask a question, pause for a few seconds to give you time to think and then give the answer. So the first question is, what are some common signs and symptoms of chronic middle ear disease?

Dr. Michael Gluth:

So common signs and symptoms would be conductive hearing loss, otorrhea, and I would think that those are sort of the two hallmark things that you want to think about.

Dr. Jason Barnes:

And you can also see maybe tinnitus, aural fullness, and then rarely vertigo facial weakness, that kind of thing.

Dr. Michael Gluth:

Yeah. So there's a wide spectrum. But I think the hallmark signs and symptoms would be conductive hearing loss and otorrhea

Dr. Jason Barnes:

Perfect. Next question, what are the eight key aspects to evaluate in the setting of chronic ear disease?

Dr. Michael Gluth:

So the eight things that we want to think about are ventilation status, eardrum status, middle ear status. We also want to think about the infection status. What's the temporal bone anatomy? What's going on with the hearing? Is there cholesteatoma, and are there complications?

Dr. Jason Barnes:

And then finally for our last question, what are the general indications for surgical intervention and what are the goals in chronic ear disease?

Dr. Michael Gluth:

So the general surgical approach would be surgery for patients that have a complication, that have cholesteatoma, that have disease that is refractory to office space medical therapy, or dry ears that have some element that is negatively impacting quality of life that might be improved with surgery. As far as the goals of surgery, we want to generate a clean dry safe stable ear. Of course the purpose of the ear is to hear. So when possible we want to restore hearing or at least facilitate hearing improvement with a hearing aid or implantable hearing device. And then lastly, render the ear favorable from a quality of life standpoint where patients if possible, can swim, get the ear wet, et cetera.

Dr. Jason Barnes:

Thanks so much for listening and we'll see you next time.