

Dr. John Marinelli:

Hey everybody. Welcome back for another episode of ENT in a Nutshell. My name is John Marinelli. And today we're joined by Dr. Ed Weaver to discuss obstructive sleep apnea in adults. Dr. Weaver, thank you for being here today.

Dr. Edward Weaver:

Thanks for having me, John.

Dr. John Marinelli:

Just for introduction sake, I do want to mention that this is obviously a very large topic. And a lot of the sub-components that we'll talk about today, like specific workup pieces, such as drug-induced sleep endoscopy. Or specific surgical management options, such as MMA will be discussed in separate episodes. But we will touch on them here. But I just say that to say that we will not go in depth necessarily on each one of these different avenues that are related to OSA in adults. But nevertheless, Dr. Weaver, let's just get started with disease presentation. So how do patients with obstructive sleep apnea present to your clinic?

Dr. Edward Weaver:

Well, I think it's first worthwhile John just defining sleep apnea. And in simple terms, it's repeated choking in sleep. So symptoms related to that is how people present. And I would say by far and away the most common symptom is snoring. Now, when we're seeing patients, they almost all snore. So oftentimes are looking beyond that to start to tease out obstructive sleep apnea. So there's a host of other symptoms. The choking and gasping in sleep itself, which defines the disorder is one of the key symptoms often resulting in recurrent awakenings. This all results in un-refreshing sleep for many patients, so that's a common symptom. Daytime fatigue and the effects of poor sleep, impaired concentration. Those are common symptoms. But among these other array of symptoms, daytime sleepiness is probably the other main hallmark symptom. So snoring and daytime sleepiness, as well as those other items.

Dr. John Marinelli:

And I understand it's a pretty common disorder. Isn't that the case?

Dr. Edward Weaver:

Yeah, it's quite common. The epidemiologic data is being updated all the time. And current estimates suggest that well more than 5% of women and well more than 10% of men have significant sleep apnea. And that's probably related to a few factors. One, the obesity epidemic. So as the population gains weight, that increases the risk of sleep apnea, because that is one of the important risk factors. Another is just that we're way more sensitive to it, paying attention to it. So patients are being tested more for it. And the testing has gotten more and more sensitive over the last two or three decades. So most people either have sleep apnea or know somebody who has sleep apnea. That's how common it is.

Dr. John Marinelli:

And in terms of other associated risk factors or comorbidities, what are common ones you see in the patients that present to your clinic?

Dr. Edward Weaver:

Well, I think the biggest one is anatomy. And snoring, it's such a prevalent issue within patients with sleep apnea. We almost look past it to tease out other factors. Obesity is a big one, but obesity affects sleep apnea probably mostly by affecting the anatomy. So when someone has excess body weight in their belly, they also have excess body weight in their neck. And some emerging data suggest excess body weight in their tongue in particular. So that can directly affect the airway. Family history is important, but probably the genetics that is propagated through the family history is probably affecting the anatomy. That's probably the biggest factor there. So anatomy and its correlates are important. Age is important just because as people age, we think the laxity that naturally occurs in tissues also increases the risk of having collapse and obstructive sleep apnea. Those are main risk factors, I would say.

Dr. John Marinelli:

And from a pathophysiology perspective, what exactly is going on in obstructive sleep apnea that's leading to the sequela that we often hear about?

Dr. Edward Weaver:

Well, just like I mentioned with the risk factors, anatomy is the biggie. There are other factors that can be at play and each of these different etiologies, the term used is endotypes, lead to a similar clinical phenomenon sleep apnea, which is the phenotype. Anatomy is top five on the list and anatomy can affect the airway in a couple of few different ways. An analogy that's often used is the airway's like a room. And if the room is too small, the little bit of collapse that naturally occurs when we fall asleep is enough to obstruct you. Or if the room has too much furniture in it, then there's not enough room. And a little bit of collapse that naturally occurs also leaves too little room to breathe.

In the last several years though, there are other physiologic factors that have been better understood. So collapsibility of the tissue. So someone might have normal anatomy, but their muscles just collapse way more readily. There's a reflex that is naturally occurring especially when we're awake that naturally opens up our upper airway. So contracts muscles in the throat and the mouth. The most important one being the genioglossus muscle, which is a muscle in the tongue that goes from the front of the mandible to the base of the tongue. When that's active, that pulls the tongue out of the way. There are others in the palate and other places in the pharynx.

When we fall asleep, those reflexes are blunted and in some they're blunted more so and that can lead to sleep apnea. And then two other factors quickly, one is ventilatory instability, and that just means regulation of breathing can get out of whack. There's a concept called high loop gain, which is where the regulation breathing is way too sensitive. So it overshoots and then undershoots corrections for breathing perturbations. And that itself can lead to a form of sleep disorder breathing or sleep apnea. And then lastly, low arousal threshold.

And that just means person wakes up too easily. And the reason that can impact sleep apnea is because having an awakening helps define some of those breathing pauses. And if someone wakes up way too easily, then even a minor breathing pause will get counted as an awakening and disrupt sleep. So if someone wakes up way too easily, that also can cause it. So all four of those factors are discussed a lot these days, but anatomy is the big one. And the treatments are aimed at addressing the anatomy, whether it's surgical or nonsurgical in various ways. And we'll, I'm sure touch on that later.

Dr. John Marinelli:

So when you bring that all together in a patient, how does that end up leading to some of the long-term sequela that we talk about such as cardiovascular disease or things like that?

Dr. Edward Weaver:

That's a really important part of sleep apnea. I would say there's two effects of sleep apnea in large terms. One is the day-to-day effects that occur from disrupted sleep and other challenges, inadequate sleep related to sleep apnea. And then the second is the long-term health implications that you just mentioned. And the long-term health implications are likely due to these physiologic perturbations. There's a fight or flight sympathetic discharge with each of these apneic episodes which are recurring throughout the night in patients with sleep apnea. There's oxidative stress from the changes in oxygen saturation. There's inflammatory response to all this and other factors. The repeated awakenings itself can cause a physiologic phenomenon.

So long-term, that translates into cardiovascular disease being the one condition that's gotten the most attention. And that's hypertension, myocardial infarction, cerebrovascular disease, stroke, arrhythmia, congestive heart failure. But really this disorder affects every organ. Because when your oxygen level's fluctuating repeatedly every night, over the course of years or decades, everything's affected. So for example, recently, in the last 10 years, dementia and permanent cognitive effects of sleep apnea are becoming more apparent. Endocrine disorders, glucose intolerance, impotence, even glaucoma is related to sleep apnea, can be excess-ed by sleep apnea and cancer. And the whole intermittent hypoxia with sleep apnea sets up a state that puts a person at risk of cancer. And a bunch of others, including death. People with sleep apnea, that's untreated, especially when it's severe have shorter lifespans. And when it's treated, they have longer lifespans. So that's a really important part of the impact of sleep apnea, is long-term health sequela.

Dr. John Marinelli:

And when you're seeing a patient in clinic, besides obstructive sleep apnea, what are the other differential considerations that are important to keep in mind?

Dr. Edward Weaver:

I think this is a topic that doesn't get enough attention among otolaryngologists. And the reason it's important is because these other conditions can mimic sleep apnea in terms of some of the symptoms. So I think of it in terms of categories of other disorders. One big important category is other forms of sleep disorder breathing. Meaning other forms of breathing problems during sleep that aren't sleep apnea. Primary snoring is one. So I mentioned earlier, snoring is the most common symptom. So a patient presents with a complaint of snoring, they might just have snoring and not have sleep apnea. However, if we just pay attention to the snoring, we might be missing sleep apnea. There's a condition called upper airway resistance syndrome, which is like a pre-sleep apnea. It's breathing pauses that don't meet criteria for sleep apnea, but has the symptoms of sleep apnea. On the other extreme end of the spectrum is obesity hypoventilation syndrome. Where in addition to the rouse of your obstructive sleep apnea, the patients have other physiologic effects that linger beyond the sleep period, hypercarbia and other problems.

And then there's central sleep apnea, which is a completely different disorder altogether. Which is where it's not obstruction keeping a person from breathing, it's just the brain not triggering breaths. That's rare to central sleep apnea, but it's important to keep in mind. So other breathing disorders. But there's a whole host of other sleep disorders that can make a person tired or fatigued or sleepy. And the most common one by far, insufficient sleep. Insufficient sleep has its own ICD-10 code, insufficient sleep disorder. So most people don't get enough sleep. So that's an important one to keep in mind. Because if a person just isn't sleeping enough and they're only complaint is sleepiness, probably they just need more sleep. Insomnia even depression, which can be associated with sleep apnea, but itself can lead to

its own fatigue. Sleep timing disorders like delayed sleep phase syndrome, which I think was touched on a bit in one of the other podcasts on sleep physiology. So there's a whole host of other sleep disorders, but those are ones that I'm asking about in almost every patient visit on sleep apnea.

Dr. John Marinelli:

And transitioning to workup now. You talked a little bit about how patients present in terms of how that might relate to taking a history. But anything else in terms of patient history that's important to get an idea of when you're seeing these patients in clinic?

Dr. Edward Weaver:

Yeah, I would say there's two important notes on that. One is just like we learn when we first start taking clinical histories in medical school, understanding the patient's chief concern is really important. And for sleep apnea, it's really important because there are so many potential symptoms, we want to make sure we're addressing what's of concern to the patient. So if the patient's only concern is snoring and they don't have any other symptoms, that might flavor how we recommend a treatment. If on the other hand, their only concern is long-term health implications and they have no symptoms. It also might affect what we recommend in a different way. So chief concern.

And then the second is we try to quantify some of these symptoms. And I would say the most common tool to quantify one of the symptoms is the Epworth Sleepiness Scale. It's widely, widely used clinically, as well as in research. It's simple, take questions, it's validated to assess sleepiness in a variety of conditions. And scoring is standardized. It's a zero to 24 scale. Zero to five is actually not sleepy enough. That's super normal alertness and commonly seen in insomnia. Five to 10 is normal. 10 to 16 is excessive sleepiness. And then 17 to 24 is severe excessive sleepiness. So when you get to the extreme end of that spectrum, 20 to 24, it's very, very sleepy. So that's one that's commonly used in sleep apnea circles. Everyone understands that instrument. So that's what I would encourage people to use, to quantify the symptoms.

Dr. John Marinelli:

And what about physical exam? What are the key features you'd like to elucidate in clinic with the physical exam?

Dr. Edward Weaver:

The anatomy is the big one, John. But let me step back from that and say, it depends on what our goal is. So if the patient's coming to us and has not been diagnosed with sleep apnea and we're trying to assess their risk for sleep apnea. Obesity, especially neck circumference are important factors. So greater than 17 inches or greater than 15.5 inches in females are known to elevate risk of sleep apnea.

But otherwise it's the anatomy. So when I'm seeing patients who I know have sleep apnea and I'm being consulted to treat the sleep apnea. I'm really assessing the anatomy for what factors are contributing to the sleep apnea. Broadly from first steps in the exam, I just look at their facial skeleton. If they've got a small, lower jaw, for example, that's either small or set back that puts them at risk because it makes the room small, so to speak. And then just go and top to bottom the nose, I'm looking at the septum and the turbinates. And the nasal valve for static or dynamic collapse. In the mouth, the soft palate gets a lot of attention. It's position, is it forward? Is it backwards? It's laxity, it's length or shape of the palate. The size of the uvula.

Tonsils of course are important in kids in particular, but even in adults, we pay attention to that. Because when the patient has big tonsils that's a correctable anatomic factor that could be affecting the

sleep apnea. We look at the tongue. How big is the tongue for the oral cavity? Are there indentations on the side of the tongue, so-called scalloping of the tongue from the teeth? Is the tongue sitting backwards? Is it sitting high and taking up space? And then there's combinations or interactions of the anatomy, especially in the mouth. So the modified Mallampati score is a commonly used metric. That's what the tongue sitting in normal position, as opposed to the tongue sticking out like the anesthesiologist use. The tongue in roll position and scoring, how open it is. It's a score of one to four.

Going a layer deeper than that, there's something called the Friedman scale, which uses that modified Mallampati score combined with tonsil size, combined with body mass index. And that's been shown when it's very favorable anatomy to predict good results with one of the main surgical treatments, the uvulopalatopharyngoplasty. Unfortunately, that particular metric isn't really useful because there's a big, big middle ground where it's not obvious simple anatomy. And the predictive ability is less useful. But it's one that's talked about a lot. And then lastly looking at the lower pharynx. So the tongue base, lingual tonsils epiglottis, either with a mirror or with an endoscope

Dr. John Marinelli:

And circling back to that Friedman scale idea. So when you say that there's a large group in the middle and that the small group that may favor UPPP's surgical success. Can you just go into that a little bit further for us? What type of patient, what does it mean to have a favorable Friedman stage that would predict good success with a UPPP?

Dr. Edward Weaver:

So large tonsils, small tongue, not obese. That's stage one Friedman, and they have 80% success with UPPP and realize UPPP includes a tonsillectomy. Some would even argue maybe just a tonsillectomy would be all that person would need. Patients with big tonsils and no other problems, they do really well with tonsillectomy, in adults, just like with kids. We just don't see it as commonly in adults. So in Friedman's own studies, that was 8% of patients.

The middle ground is someone with big tonsils, but also other problems, like a big tongue or some obesity. Or they have small tonsils and a small tongue and it's not clear what the anatomy problem is. That's the middle ground. And that's where tonsillectomy alone or UPPP alone is commonly not adequate to treat the sleep apnea. And that's stage two. And then stage three is the patients who have bad anatomy for a UPPP, they have small tonsils, big tongue and, or are really obese. In those cases UPPP alone has a very low chance of adequately correcting the sleep apnea. So when a patient has big tonsils and that's the only problem, Friedman is suggestive that they'll do well. And there are other data that don't even use Friedman to suggest those patients do well with surgery aimed at the tonsils and, or the palate.

Dr. John Marinelli:

The other thing is you mentioned endoscopy, are you taking a flexible scope to these patients in clinic?

Dr. Edward Weaver:

I don't, but I think most people do. When I do, I'm mainly trying to assess the dynamic collapse. I feel like I can get a good exam of the static anatomy without the scope in most cases. So what do I mean by dynamic collapse? Not just is the palate in a vulnerable position, but does it in fact collapse and obstruct the airway? Or does the tongue collapse? Now, this is controversial. How do you get the airway to collapse when the person's awake and their muscles aren't relaxed in the same way as they are when they're asleep? There's a couple maneuvers to do that can help with that. One is just lay the person

down. And you might see the tongue, for example, collapse a lot of the way, if not all the way. The person could still breathe, even with a small airway and the reflexes are holding it open enough so they can breathe fine. But then it really raises the suspicion that when they fall asleep, that last little bit of collapse is going to be enough to cut off their airway.

Another maneuver is something called the hypotonic maneuver and that is have the person take a large breath in and then exhale all the way. And not just exhale all the way to comfort, but exhale all the way to completely eliminate air in their lungs. And at that very end expiration, there's a reflex that relaxes the pharyngeal musculature. So you can somewhat mimic what's happening during sleep with this hypotonic maneuver. And then pay attention to what happens in that moment when they're at an exhalation. And if you see collapse, those are suspicious sites as well. So why don't I use this in clinic? Because I'm almost always doing a sleep endoscopy, which I'm sure we will touch on in a moment. Which is another form of endoscopy, but done under sedation in a monitored setting.

Dr. John Marinelli:

Yeah, I think maybe let's just transition to that now. When are you getting drug induced sleep endoscopy?

Dr. Edward Weaver:

So this is also variable from surgeon to surgeon. I do it on pretty much every case I'm operating on, just to gain the information, even if I know exactly what I'm going to do for surgery. So for example, let's say the patient has a nasal issue, and that's really the only issue I'm treating. The sleep endoscopy is not real relevant to the nose. But I'll do a sleep endoscopy to assess the rest of the airway, just to gain insight or information in case whatever strategy we had in mind with the nasal treatment alone, possibly with another device treatment or something. I have a better understanding of what's going on. If I'm planning pharyngeal surgery, I usually have a pretty clear plan in mind from my anatomy exam. But I'll be ready to tailor it and I'll personalize it based on the sleep endoscopy.

If I'm not clear on what all might be involved, I might leave a few options open in the surgical plan with the patient, depending on what I saw on sleep endoscopy. So that's one approach. Another approach is doing the sleep endoscopy as its own standalone procedure. I don't do that. I don't really have the facilities to do that. But some surgeons will evaluate a patient in clinic and then schedule a sleep endoscopy, do that as its own outpatient standalone procedure. And then regroup with the patient to formulate a surgical plan based on the sleep endoscopy. And then some people don't do sleep endoscopy at all. In Australia, it's not used very much. It had been in the past, they felt it wasn't high enough yield. So my Australian colleagues rarely usually sleep endoscopy, at least a lot of them rarely use sleep endoscopy. So it's one of the controversial topics. A lot of us think it has an important role, but that exact role is still being defined. And that's why you have this variability in how it's used.

Dr. John Marinelli:

Any role for imaging here, like CT or MRI or that sort of thing?

Dr. Edward Weaver:

Not in the diagnosis or workup. I would say just in surgical planning. So certain surgeries warrant X-rays, CT scans, such as skeletal surgery, but otherwise not routinely used. Cephalometrics had been used in the past and there's risk factors associated with certain cephalometric findings. So those are lateral facial skeletal X-rays and something called a panorex X-ray, it's for the jaw. But honestly we don't need those to diagnose sleep apnea. You really need a sleep test to diagnose a sleep apnea. So the X-rays

don't really serve that role. So part of the workup is certainly before doing invasive treatment is sleep testing of some kind to document the sleep apnea and assess the severity of the sleep apnea.

Dr. John Marinelli:

And we cover in depth discussion of interpreting a sleep study in another episode. But I think it's worth mentioning, especially in terms of the formal diagnosis of obstructive sleep apnea. What is the formal diagnosis of obstructive sleep apnea?

Dr. Edward Weaver:

So I'd mentioned the working definition earlier repeated choking, or repeated upper airway obstructions during sleep. How that's operationalized is honestly test that's measuring breathing and a whole host of other factors including sleep on a formal polysomnography. If the person has five or more obstructions per hour of sleep, that's the threshold to define sleep apnea. And then what defines an obstruction? It can be either complete obstructions, those are apneas or partial obstructions with ramifications. Those are called hypopneas, the ramifications might be awakenings or might be oxygen drops. So five or more per hour of those define sleep apnea.

Now, there's this concept of obstructive sleep apnea syndrome. And that is that physiologic abnormality of sleep apnea with symptoms. The syndrome is defined as occurring with symptoms. So patients who have five or more episodes with symptoms, we consider that an important degree of sleep apnea because of the symptoms. If it's 15 or more, it's important, whether or not they have symptoms. And that's because with 15 or more, the epidemiologic data suggests the person as a measurable, increased risk of the health implications we discussed earlier, like cardiovascular disease. So long answer to short question, but five breathing pauses per hour with symptoms or 15 or more breathing pauses per hour warrant attention.

Dr. John Marinelli:

And how do we define mild, moderate, and severe?

Dr. Edward Weaver:

So mild is that lower end of the spectrum where they have five to 15 breathing pauses per hour. Moderate 15 to 30 and severe greater than 30. The epidemiologic did oftentimes breaks down into these categories. So you hear a lot of severe sleep apnea has increased risks. Moderate has a little bit increased risk, mild appears not to. But it's important to understand that nothing magical happens between the cutoff of 15 and 16 from mild to moderate. 16 is the same disease as 15. Those are constructs that we've created to just categorize. So I'll oftentimes refer to a patient who has an apnea hypopnea index of 14, 15, or 16 as mild to moderate. Because it's right on that bridge.

Dr. John Marinelli:

The other thing just related to this mild, moderate, severe idea, how do oxygen saturations play into this?

Dr. Edward Weaver:

That's a really important point because the flow limitations of obstructive sleep apnea appear to be of less importance than the fluctuation in oxygen levels. Now, who people have apneas complete obstructions, usually have some fluctuation in oxygen level. But people with hypopneas, the partial

obstructions and arousals, may have no fluctuations in oxygen levels. It's the fluctuation in oxygen levels that appear to be the most prominent risk factor for long-term health implications among the factors we measure. Another measure on oxygen is how much time or what percent of the sleep time does a patient spend with an abnormally low level.

And that also is predictive of long-term health issues. Although only when it gets into the moderate and severe range, which tends to be less common than the fluctuation abnormalities. So those I pay very close attention to. In fact, I often will tell people in lectures or trainees, the single most important measure on the sleep test, in my opinion, is the oxygen desaturation index. It's not the apnea index or the apnea hypopnea index. It's the oxygen desaturation index, if we're going to look at a single measure. In reality, we look at a whole host of measures, the ones we mentioned here and a bunch of others to get a gestalt on how bad the sleep apnea is.

Dr. John Marinelli:

What would you say to a trainee in terms of oxygen desaturation index? What starts to make you worried?

Dr. Edward Weaver:

Similar cutoffs to the apnea hypopnea index, but with the desaturations. So 15 or more per hour suggest increased risk of the long-term health implications. Now, I'd mentioned earlier two main issues with sleep apnea, these long-term health implications and then day-to-day effects, symptoms, and functional effects. It turns out the sleep test does predict the long-term health implications and that's what we're focusing on right now. It turns out the sleep test tells us nothing about symptoms among patients who present for sleep apnea. So someone might have very mild sleep apnea and very severe symptoms, very severe sleepiness, very severe other symptoms or vice versa. They might have very severe sleep apnea and almost no symptoms.

So we don't use the sleep test at all to assess symptoms. We ask about the symptoms and the day-to-day effects directly. But we do use it to anticipate the health implications. And the desaturation index, I think, is the single most important measure, especially if it's 15 or more. And even more, especially if it's 4% desaturations rather than just 3% desaturations. So this is a whole rabbit hole we could get down, because there's a lot of debate on how we should even be looking at all these multitudes of parameters. But to break it down into a nutshell, so to speak, I think the 4% desaturation index is probably the single most important measure.

Dr. John Marinelli:

So now that we've covered presentation, pathophysiology, workup, and diagnosis, I just want to transition to treatment. How should we think about medical management in the context of obstructive sleep apnea?

Dr. Edward Weaver:

One of the gratifying parts about sleep apnea is there's multiple ways to treat it and multiple specialists to engage in the treatment of it. When I see a patient, the first thing I do is try to decide whether treating the sleep apnea is worthwhile. Especially if they have other comorbidities that might be responsible for their symptoms. So taking that step back and really deciding whether treatment's even warranted. Because we sometimes fall into a trap where the patient has a sleep test, they have a diagnosis of sleep apnea. And we forget everything else that might be contributing to their symptoms.



So that's an important first part. Related to that is sometimes my recommendation is no treatment at all. Just leave the sleep apnea alone, because it's not part of the problem for that given person's concerns. That happens sometimes. I'm going to go from least invasive to most invasive. So least invasive would be no treatment at all. Next is behavioral modifications. We call that sleep hygiene, having a regular sleep schedule. Getting enough sleep I'd mentioned earlier. Insufficient sleep is the most common cause of sleepiness. If that's the main issue, just get enough sleep. Easier said than done, maybe, but at least we can understand how to treat it. And avoiding sedatives like alcohol or medications, because those can exacerbate sleep apnea.

I would say the next step up from there weight loss. Excess body weight is one of the risk factors for sleep apnea and so weight loss can help treat sleep apnea. The problem is substantial weight loss is really, really difficult. And I don't recall ever seeing a patient who had a weight problem and I was seeing them for sleep apnea who had not already tried to lose weight. And most of the time, many, many times. So I talk about it, but I don't withhold other treatments while waiting for weight loss. Now weight loss might include an invasive treatment, surgical weight loss and that can play important role in the very obese patients. Next up, positional therapy.

For some people sleep position really dictates their sleep apnea. They only have sleep apnea when they are on their back and they have very little or no sleep apnea when they're off their back. So there's a whole host of strategies to help a person stay off their back when they're sleeping. Medications, a lot of medications have been investigated. They don't really have a role in treating sleep apnea directly. With one potential exception that's on the horizon and that is a hypnotic agent or a sleep agent to help the patient with low arousal threshold. So who we think their sleep apnea is really due to, do they wake up too easily. But those are rare.

Stimulant medications are used sometimes for patients with sleep apnea to help fight the sleepiness. Once their sleep apnea is treated, and if they have residual sleepiness, which can happen. So say a person has received a treatment, it's fully controlled the breathing problem, but they still have sleepiness. Then we might give them an alerting agent. Modafinil being the commonly one used. It's actually FDA approved for this particular indication. Those are the main roles for medications as well as treating other comorbidities.

So for example, if someone has gastroesophageal reflux disease, we'll treat them potentially with medications. And then we get into the big three treatments. CPAP is the gold standard. I can touch more on that. Mandibular advancement devices that position the mandible forward, in some patients work really well. I can get into more detail on that if desired. And then surgery. And that's what I do. And that's what otolaryngologists main role in treating sleep apnea is and surgery is a large topic itself. Those are the three main treatments for sleep apnea.

Dr. John Marinelli:

Maybe we could just start with the mandibular advancement devices. What patients are good ones that might benefit from that?

Dr. Edward Weaver:

The literature suggests that patients with milder sleep apnea are more likely to do well with an oral appliance device or a mandibular advancement device. But it's important to understand there's a little bit of a fallacy built in there. And that is the outcome being assessed in those studies is milder sleep apnea. So if you start with milder sleep apnea, you're more likely to get to milder sleep apnea. So there's a little bit of a circular argument. Same has been used for surgery. We now have expanded our horizon,

our view of what we look out for outcomes. And we don't just look at the apnea hypopnea index. We look at symptoms and the day-to-day effects of sleep apnea and long-term health.

So I think there's a more personalized specific approach to assessing a good candidate. They have to have adequate teeth because the oral appliance device anchors to the teeth. And more specifically, ideally at least one molar in each quadrant. So one upper left, one upper right, one lower left, one lower right. One or more in each of those quadrants to adequately anchor. There are exceptions or ways, but really specialized orthodontists and dentists can fashion oral appliances. They're not ideal candidates, but it's challenging.

The second is something we, as otolaryngologists can easily examine is a protrusive capacity. That means can the person stick their lower jaw forward? Some people just can't stick it forward very far at all. In those cases, a mandibular advancement device's unlikely to be helpful. And then I'd say the third favorable feature is a person with an overbite. So class II malocclusion, meaning the lower jaw is set back from the upper jaw. If they have adequate protrusive capacity, the effects of the oral appliance, one of the side effects is that it can move the teeth. And in those people, it can move the teeth and actually improve their bite. So the adverse effect of teeth movement might actually be a favorable side effect.

So those people tend to be the very best candidates, but you know what? I think about mandibular advancement device in almost all patients as an option to at least consider. Because even if they're not ideal candidates, it might mitigate their sleep apnea. And especially for a person who just doesn't tolerate or is not a good candidate for any other treatment. That's something that we should definitely have in our toolbox to consider. And the process there is basically consult a dentist who fashions these devices and manages them. Some otolaryngologists will do this and are capable of doing this. But usually it's done by a dentist who has experience with these sleep devices.

Dr. John Marinelli:

Maybe now we could transition to the gold standard therapy, positive airway pressure. Can you touch on that next please?

Dr. Edward Weaver:

Yeah, that's a whole lecture discussion conversation in and of itself. But I think it's important for otolaryngologists to be able to discuss this topic with patients. Because most of the adult patients either will have tried it or should try it. So what is CPAP? It's continuous positive airway pressure and conceptually it's simple. It's something that's holding air pressure in the upper airway, the pharynx, via the nose or via the nose and mouth. And that air pressure keeps the tissues from collapsing. That's the concept. There's a variety of different types of devices that all achieve that goal. Continuous positive airway pressure is a fixed pressure based on settings that are determined on testing or other ways. Auto-adjusting PAP device does just that. It adjusts the pressure on the fly to increase or decrease depending on whether it detects reduction in breathing or airflow. And each device has a detection mechanism built in. Bilevel positive airway pressure, commonly known as BiPAP is fixed pressure, but it's a different pressure breathing in than it is out. So it detects when the person's breathing in versus out and adjust the pressure to a lower level when breathing out.

And that's used in particular for patients who experience extreme discomfort with exhaling while trying to sleep, they feel like they're suffocating. And typically it's in patients who require high pressures to treat the sleep apnea. Sometimes the bi-level will alleviate that discomfort. And there's even something called BiPAP adaptive servo ventilation, ASV. And that's for patients who don't just have obstructive sleep apnea, but also have an element of central sleep apnea. And it's almost like a mini

noninvasive ventilator. It'll actually detect if the person's not breathing and give a breath. Not just positive pressure, it would actually give a breath.

So I don't manage any of these, even though I am board certified in sleep medicine. I leave that to my sleep medicine colleagues. Because within each of those categories, there's a whole bunch of other tools and adjustments and setups that can be used in various specific circumstances. But if a patient comes to a surgeon and has tried one pressure and has tried it for one week and has had no adjustments or no other consideration of other devices. To me, that's a sign that they may not have had an adequate trial of CPAP because CPAP notoriously requires troubleshooting to achieve optimal comfort and effect. So that's why it's important to have some understanding about these various types of CPAP devices.

Dr. John Marinelli:

How effective is CPAP in terms of, we've talked about some of those long-term sequela. Does it mitigate that substantially or what does the dentist say about that?

Dr. Edward Weaver:

John, can I put on my clinical epidemiologist hat for a second?

Dr. John Marinelli:

Yeah.

Dr. Edward Weaver:

So there's a term called efficacy and a term called effectiveness. Efficacy is how well a treatment works under controlled ideal conditions, say in the laboratory or in direct observation or in a trial, for example. CPAP has high efficacy, meaning if the person is wearing it through the night and it's set up well, it works great to treat sleep apnea. You can obliterate sleep apnea. And it's fascinating to watch this while a person's getting a sleep test who has really severe sleep apnea.

And then you put a CPAP on them and when it's set optimally, the sleep apnea disappears. It's profound to watch. However, many patients have trouble achieving that ideal situation and gaining the efficacy. So this concept of effectiveness is how well it works in the real world. And the big issue with CPAP is it's hard to use for a lot of patients. So they use it part of the night or only some nights or not at all. And then it's not having the effect. So when it's working, when it's being used, it does really well in controlling the breathing problems, the physiology problems. It does quite well in controlling the symptoms, it controls snoring. It oftentimes improves sleepiness and other day-to-day effects of sleep apnea.

And it improves long-term health. Now that last statement is a little bit controversial, because there's been some trials that suggest it does not improve long-term health. However, those are under certain specific circumstances where the CPAP isn't the optimal mode of treatment. And I think there's so much evidence that suggested and proves long-term health in general that yeah, we rely on it for that effect as well. So very efficacious effectiveness, about 50%, meaning about half the people do quite well with it about half the people don't.

Dr. John Marinelli:

How much do you need to be using it in order to achieve those benefits? In other words, what is adequate use?

Dr. Edward Weaver:

That's one of the Holy Grails in the field of how much is enough. The short answer that we use is four hours per night on five nights per week, which is 70% of nights. And that's the standard used by insurance companies to define adequate use that they will continue to cover the device, actually buy the device for the patient. So the patient has to demonstrate that much use over a 30-day period in order for insurance to pay for the device. And there's some epidemiologic data to suggest that that cutoff predicts some measurable benefit of the CPAP. It gets complicated in that the more you use it, the bigger the effect. So five hours a night is better than four. Four is better than three. The number of nights used is also a dose response. The more you use it the better.

And it depends on what outcome you're measuring. So some outcomes might only require four hours a night to achieve whatever effect you're going to get with the CPAP. Some might require seven hours per night. So we are in our infancy in understanding all these nuances of the use of the device and the outcomes. For practical reasons, we use four hours a night, five nights a week as a cutoff. Because then the patient, if they don't achieve that, we pretty much consider them not adequately treated and it's really worth looking at other treatment options.

Dr. John Marinelli:

And lastly, any important contraindications to keep in mind for CPAP use or APAP use?

Dr. Edward Weaver:

Rare. As my colleague Tucker Woodson, who's one of the major figures in sleep surgery often says is the only way you can hurt yourself with a CPAP is if you drop it on your foot. That's not entirely true, but it's 99% true. The rare circumstances where it's really contraindicated is... Well, one is if there's intolerable side effects. Those are common. But short of that, it's skull base defects. So if a person has a CSF leak, there's a risk of creating pneumocephali by putting extra positive pressure in the upper airway, in the nose. If they have lung problems, sometimes the CPAP is contraindicated. So it's rare situations where it's contraindicated.

Now, patients having difficulty with the device, such that for example, some patients will get recurrent sinusitis when they wear the device. Or they'll get air leaking out of the mask. It causes a lot of symptoms or even air leaking through the nasolacrimal duct if they have a patent nasolacrimal duct into the eye or aerophagia. Which means too much air going into the stomach, which can be extremely uncomfortable and disruptive to a person throughout the whole day. Those are relative contraindications if they can't be addressed with troubleshooting.

Dr. John Marinelli:

And now transitioning to surgical management. As we mentioned in the beginning, we'll cover some of these areas in much more detail on different episodes. But could you just talk a little bit about surgical management and give us an overview of how to think about that?

Dr. Edward Weaver:

Yeah, there's three main roles for surgery in the treatment of sleep apnea. One role is as an adjunct to those other treatments, say CPAP or oral appliance therapy. And the goal of the surgery is to facilitate those devices. The goal of the surgery is not to treat the sleep apnea per se. So the most common scenario for that is nasal surgery. And in fact, that's very common. We do a lot of this to facilitate CPAPs or oral appliance therapies. Because the nose's compromising the patient's ability to tolerate it, or the effectiveness of those devices. But there are other surgeries too. I'll do tonsillectomy in patients who

have really big tonsils, but have a whole bunch of other issues contributing to the sleep apnea. And my goal is really to lower the pressure requirement on the CPAP. Because the big tonsils are just making the CPAP work too hard.

So that's one role, adjunctive treatment. A second is as a primary therapy, meaning the patient hasn't had any other treatment for sleep apnea and we're using surgery as the main mode of treatment. That's rare in adults, but the circumstances, the one we touched on earlier when we were talking about the Friedman staging. And that is a young person, who's not obese, who has pretty much normal anatomy, except very large tonsils. Those patients have well over 50% chance of eliminating sleep apnea and 80 to 90% chance of making the sleep apnea trivial and no longer requiring treatment. And even if they do have residual sleep apnea after that, having those big tonsils out of the way will facilitate CPAP or other therapies like I just mentioned. So that's a situation where I would be thinking about surgery as primary therapy.

And then the third role for surgery, and this is the one that people think about when they think about sleep surgery is a salvage. For the patient who was not able to tolerate or use CPAP for whatever reason. May or may not have considered oral appliance device therapy, depending on their personal situation, anatomy and so forth. So that salvage role for surgery is the one we think most. And part of the value of breaking it down into these roles is we have different goals for each of these roles. So the goal for the adjunctive treatment is not to treat the sleep apnea. The goal is to facilitate the other treatment for sleep apnea. The goal for the primary therapy is to eliminate sleep apnea and we use the other therapies as salvage.

And the goal of salvage therapy while ideally is still eliminate the sleep apnea, that's usually not realistic. You've got to realize these are patients who failed other therapies. It's really to improve the sleep apnea enough, such that it's worthwhile. So getting them to the mild range and controlled symptoms, even if not eliminated. Most of us who do sleep surgery would consider that perfectly adequate. In terms of what procedures are used, boy there's a whole host. But I'll summarize them by saying it's addressing the abnormal anatomy we see on the exam and that illustrates the importance of the exam. And in particular, the specific anatomies we might see on the exam that warrant therapy.

Dr. John Marinelli:

So how would you decide when to do which procedures?

Dr. Edward Weaver:

There's a whole host of procedures to use, John. So that's part of the art of sleep surgery. But I think of it in two broad categories of procedures. One are site specific procedures. So as I was mentioning earlier, procedures to address very specific anatomic abnormalities, big tonsils, remove the tonsils. And then the second broad category, what I call global airway procedures, meaning they address multiple areas of the upper airway at once. So let me touch on site specific procedures because I think that category is the more commonly used surgical treatment for sleep apnea. So I mentioned nasal obstruction, nasal surgeries, and that might be turbinate reduction, septoplasties, a whole host of functional septorhinoplasties. The most common one though I would say is surgery of the palate and velopharynx. So that's the uvulopalatopharyngoplasty and modifications of the uvulopalatopharyngoplasty.

And there's a couple key concepts I think to understand about that. Operation. One is it's not one operation. And the analogy that I think illustrates that is it's like saying rhinoplasty. When we say rhinoplasty, it's not one technique. There are a whole host of things one might do under the rubric of rhinoplasty to address a person's nasal deformity or airway problems. Likewise, with UPPP, there's a whole host of things we might do to address a person's airway or collapsibility problems. So if they have

a big uvula, you might trim the uvula. We usually try to preserve the uvula if it's not big. If they have big tonsils or any tonsils, we tend to remove them. If they get collapsed front to back, we might do versions of the procedure that stabilize the palate from collapsing or help position it forward. If they get collapsed from the sides, the parapharyngeal muscle, which is the large muscle on the side of the oropharynx. There are procedures to reorient that muscle.

And I won't go into the technical details of all the names of these procedures. But it's really important to understand that the UPPP operations are reconstructive procedure that's directed at the problems that one observes in that part of the anatomy. That's in contrast to old versions of UPPP, which was excisional. We'd literally take a Bovie and cut off part of the palate and uvula and just oversaw it. And while that can help sleep apnea, it has a lot more side effects and doesn't help as much as these newer techniques. And then moving on from there, if there's big lingual tonsils, we remove those. If the tongue is big or collapsing, we can do things to reduce the tongue. Whether it's with a robotic surgery or even directly, or ablation techniques. We can advance the tongue with certain techniques like genioglossus advancement. Or hyoid suspension that use skeletal anchor points to help pull these structures forward. We can even do direct surgery on the epiglottis or the arytenoids if those are collapsing.

So there's a whole array of procedures and oftentimes it's a combination that dictate what might be included. Oftentimes these are staged. We'll do what we think is affecting the sleep apnea, see what happens. If it's not enough, go on and do more. Especially because sometimes a secondary set of obstruction may appear only after the first primary set of obstruction is addressed. Moving on to the global airway procedures. There's four main ones, maxillomandibular advancement or jaw advancement where you move the upper jaw and the lower jaw forward. It's a form of orthognathic surgery. Technically it's telegnathic surgery. That's often done by oral maxillofacial surgeons. Very handful of otolaryngologists who do that, who've done the training for it. That can be really, really effective treatment, but even it doesn't cure sleep apnea in most cases. But it does tend to really improve sleep apnea. It's a major undertaking.

So most patients don't elect to go ahead with that surgery, but it's definitely one of the options. Especially in someone who has a maxillofacial deficit on exam. One that's gaining a lot of popularity in the last 10 years is hypoglossal nerve stimulator. I think that you're going to have a whole separate session on that. One of the really exciting things about that therapy is that it has a physiologic effect rather than an anatomic effect. It counters the tongue collapse and potentially palatal collapse by activating motor neuron, the hypoglossal nerve to recreate that reflex that would occur when you're awake.

So there's a lot of excitement about that treatment. It's important to understand that so far the main studies in it have been in highly selected patients. So as more experience is gained and more studies come out to generalize what all patient situations that would be useful for. I think it's role will be better defined. Tracheotomy has an important role, although it's rarely applied. And that's typically when a patient has really bad sleep apnea and has critical other comorbidities that make the other treatments not real viable.

And then lastly, bariatric surgery. Major weight loss, we think has a diffuse effect in the airway. Maybe mostly on the tongue, but there are other parts of the airway where excess body weight might impact the sleep apnea. So that's an important mode of therapy to consider when the person is obese. Especially when they have class II or III obesity, meaning body mass index greater than 35 or 40. So that covers the full range. But I would say UPPP is the one that's used most because the palate is probably the most common set collapse or obstruction. And understanding that it's a reconstructive operation are the important take home points.

Dr. John Marinelli:

And what about just transitioning to outcomes, prognosis, that sort of thing, just overarchingly as we finish up surgical management, how should we think about the different surgical outcomes and just what that means for patients going forward? I know there's many options, but if there's a way to sum that up.

Dr. Edward Weaver:

Well, I had mentioned earlier I think it's useful to break it down into symptoms, day-to-day effects, and long-term health effects. If we can get the sleep apnea on sleep testing into the mild range, and by the way, I strongly urge everyone to get sleep testing after the person's recovered from surgery.

Typically, I do it at four months after surgery. If we can get them into the mild range or better, I don't worry about the long-term health effects. So I check off that box and then I ask them directly about symptoms. The Epworth sleepiness scale is a commonly used measure. We talked about earlier. If that is no longer in a problematic range and other symptoms are addressed, those are the realistic goals for surgery and for any treatment, really. If we haven't achieved those goals, then we might move on to other treatments or we might move on to an additional surgery, a secondary stage surgery. Or commonly, I'll have a patient who's achieved partway to those goals, but not quite. And now their residual sleep apnea is positional where it wasn't before.

So I might recommend positional therapy to compliment the surgery. Or an oral appliance device to compliment the surgery. Or a retrial CPAP because they might not tolerate CPAP where they didn't before, because the sleep apnea is not as bad. Or weight loss or any of the other treatments. So one of the important concepts in treating sleep apnea is it doesn't have to be isolated to one treatment option. You can combine treatment options. In fact, it's very common that we do that. And that requires us interfacing also with our colleagues in different subspecialties who also treat sleep apnea. And part of what makes this field a lot of fun and exciting to work in, to learn from our colleagues and to compliment what they can do with what we can do.

Dr. John Marinelli:

And you mentioned getting a postoperative sleep study done at four months. Any other pearls surrounding followup for these patients?

Dr. Edward Weaver:

Acutely after surgery, of course, monitoring for side effects and adverse effects and managing those. Mid range, I say four months for the sleep test, just to give time for them to completely recover from the surgery and time to reestablish their sleep patterns. So we're trying to assess how they're going to be in the longer term. As a side note, a lot of people wonder if the effect of surgery is due to weight loss. The answer to that question is no. Patients do lose weight after pharyngeal surgery, because it hurts so much in the short term. They pretty much all gain it back as soon as they start eating. And that's born out in many, many studies that patients go back to their baseline weight and the treatment affects is not due to weight loss.

So part of doing it at four months is not to exaggerate the treatment effect because of some residual weight loss that hasn't reached its new plateau. And then long-term is assessing for recurrence of sleep apnea, recurrence of symptoms, or further treatment if that's needed. Some people will follow their patients every year. In my practice, I leave that to the sleep medicine colleagues with whom I work very closely. And if the patient has worsening of symptoms, they might reconsult me to reassess for further surgery or else they might try some of these other therapies down the line if they occur. It's

important for patients to understand, to be cognizant that their symptoms may reoccur. So if that happens that they should bring themselves to medical attention.

Dr. John Marinelli:

Well, Dr. Weaver, I think that pretty much wraps up all the questions I had. Was there anything else that you wanted to mention or things that we didn't cover that you think is worthwhile?

Dr. Edward Weaver:

John, there's one last pearl that I think is important to share with your audience. And that is that sleep surgery is a lot of fun and certainly a subspecialty worthy of any trainee's consideration.

Dr. John Marinelli:

All right. Well, Dr. Weaver, thank you so much for your time today.

Dr. Edward Weaver:

Well, thank you very much for having me, John.

Dr. John Marinelli:

All right. Now I'll transition to the summary portion of the podcast. So obstructive sleep apnea in adults is a sleep disorder characterized by periodic complete or partial upper airway obstruction during sleep. That causes intermittent apneas, hypopneas or both despite ongoing respiratory effort. Symptomatically, patients will commonly present with snoring, which can be either endorsed by saying that there's choking or gasping during sleep, recurrent awakenings. Or just saying that there's a lot of daytime sleepiness where they just feel like their sleep is un-refreshing. Sleep apnea is very important in terms of patient's long-term health.

There's multiple comorbidities and long-term sequela associated with obstructive sleep apnea. On physical exam, it's important to get an idea of things like obesity, neck circumference, but also patient's anatomy. Get an idea of things like the Friedman staging, which uses their tonsil size, modified Mallampati, or their tongue position, as well as their BMI. Things like that to help you get an idea of what's the patient's anatomy and where's the level of obstruction. In terms of treatment for sleep apnea, really positive airway pressure is the gold standard treatment. But bearing in mind that adherence to positive airway pressure is very low oftentimes. And for that reason, surgical management of sleep apnea is something that is significantly studied and is obviously relevant to otolaryngology. There's numerous procedures that can be done. Everything from addressing nasal surgery, to help tolerance of sleep apnea, to the UPPP. Or global airway procedures such as maxillomandibular advancement or hypoglossal nerve stimulators.

And lastly, just keep in mind that the treatment of sleep apnea in adults is a very multimodality, holistic approach. Where we might offer surgical therapy to somebody and that treatment may not cure their sleep apnea. But instead it might enable them to tolerate positive airway pressure. Alternatively, you might do a surgery and it might be a multiple stage procedure. And the whole goal is to eventually get them into the mild range where their risk of long-term cardiovascular sequela is significantly mitigated. All right. Well, that'll wrap things up for the summary. I'll transition to the question portion of the podcast. While I ask a question, pause for a couple seconds to let you think about the answer and then give the answer.



So first question of the day, what is the definition of obstructive sleep apnea? So obstructive sleep apnea is a sleep disorder characterized by periodic complete or partial upper airway obstruction during sleep. Causing intermittent apneas, hypopneas or both despite ongoing respiratory effort. Second question, generally speaking, what polysomnogram findings suggest treatment is warranted? Whether a polysomnogram or a home sleep study, in patients with an AHI greater than equal to five. In a symptomatic patient or greater than or equal to 15. In an asymptomatic patient, meets the criteria for obstructive sleep apnea and warrants treatment. Keep in mind that in adults, the severity ranges go from five to 15 for your AHI is considered mild. Moderate is 15 to 30 and severe is greater than 30.

Third question. What does the Friedman staging system assess? The Friedman staging system is used as a clinical predictor of which patients might have successful postoperative outcomes from a UPPP. Or even just a tonsillectomy potentially. And what it takes into account is the patient's non extended tongue position or the modified Mallampati tongue position, the tonsil size, and patient's BMI. Where the more favorable the tongue position, the lower the BMI, and the larger the tonsil size pretends a greater likelihood of surgical success. And last question, what surgical intervention has been shown to improve CPAP tolerance, but does not significantly alter a patient's AHI? This procedure's of course the septoplasty and bilateral turbinoplasty, inferior turbinoplasty, or really just this whole idea of nasal surgery. Nasal surgery is not necessarily going to lower a patient's AHI. But it may improve their ability to tolerate positive airway pressure. Well, that'll wrap things up for today. Thanks so much for joining us and we'll catch you next time.