Dr. John Marinelli:

Hey everybody. Welcome back for another episode of ENT In A Nutshell. My name is John Marinelli, and in this episode, we're going to be talking about drug-induced sleep endoscopy with Dr. Eric Kezirian, who is board certified in otolaryngology as well as sleep medicine, and of particular relevance to today's episode is someone that really has tremendously contributed to this topic over his career. So, Dr. Kezirian, thank you so much for taking the time to be here today.

Dr. Eric Kezirian:

Oh, it's my pleasure. Thank you for having me.

Dr. John Marinelli:

Before we get too much into the nuts and bolts of drug-induced sleep endoscopy, I wanted to first just cover some background on the procedure and why it's done and whatnot. Could we start off by talking, just basically, what is drug-induced sleep endoscopy?

Dr. Eric Kezirian:

Drug-induced sleep endoscopy is endoscopy, so it's fiber optic, usually flexible fiber optic, examination of the pharynx, of the throat, under sedation. So it's drug-induced, but it's done in a way to, as closely as we can reasonably, mirror natural sleep. So, it's drug-induced because of the sedation, but it's sleep. It's not just giving sedation in a haphazard way, but the idea is that you perform endoscopy of the throat to basically look at the areas that are causing the obstructive sleep apnea, what structures are physically blocking the airway and identifying them as a precursor to treatments. Not just including surgery actually, but also including oral appliances or mandibular advancement devices. The idea behind it is that: We want to understand what the anatomic causes of obstructive sleep apnea, and potentially see the role of specific treatments through different maneuvers we can perform during drug-induced sleep endoscopy.

Dr. John Marinelli:

Just building off that, when we think clinically, and you're seeing a patient with obstructive sleep apnea, what are the clinical scenarios in which you're thinking to yourself, "This would be a good time to go down the pathway of drug-induced sleep endoscopy?"

Dr. Eric Kezirian:

Sure. First and foremost, I think, even though we are surgeons and we often think about potential surgical treatment for someone with obstructive sleep apnea, the frontline treatment for obstructive sleep apnea is absolutely positive airway pressure therapy. There are some patients that can consider oral appliances as a first-line option, and that can do very well, but I actually think they have a little bit more in the way of potential side effects than positive airway pressure therapy does, which is why I always use positive airway therapy first. It's for those patients that do not tolerate, do not respond well, to positive airway pressure therapy, that's when I start thinking about other options, including surgery and oral appliances, and that's when drug-induced sleep endoscopy can come into the picture.

There certainly aren't many patients for whom it's almost obvious what the cause might be. Especially for example, if they have marked Palatine Tonsillar Hypertrophy, like those three plus and four plus tonsils, those are patients who generally are going to do really well with a surgery that takes out those tonsils, and potentially including some component of palate surgery added to that. There are

some cases, of course, where they may need other things done at the same time, but for those patients, drug-induced sleep endoscopy may not be that helpful, because it's not probably going to change your management dramatically. Of course, when you look in the airway, you might just end up seeing these huge tonsils there, so it might not be such an informative evaluation anyway. But, I think about drug-induced sleep endoscopy, and I perform it in about, I'd say, half of my patients undergoing sleep apnea surgery, where I really think that may change, what I would recommend, and potentially what the patient would want to undergo as far as treatment, so I think it has a real role as an evaluation procedure. Sort of getting a little better handle on the diagnosis in terms of the anatomic features of their sleep apnea [inaudible 00:04:05] causes of their sleep apnea that you would address potentially with surgery or even oral appliances.

Dr. John Marinelli:

I know historically there's been an evolution to where we are today in terms of using drug-induced sleep endoscopy, initially evolving even from things like using the Mueller maneuver and things like that. Can you touch on, a little bit, about how we got here in terms of just recognizing the variation in surgical outcomes reported in the literature and just the role of drug-induced sleep endoscopy in that context?

Dr. Eric Kezirian:

Sure. The first option as far as treatment for obstructive sleep apnea was actually surgery being tracheotomy. Now, that's not the most common treatment for obstructive sleep apnea anymore, but as you have the development of positive airway pressure therapy, uvulopalatopharyngoplasty, it was pretty much you had a couple of options, there wasn't really much to choose from. Things could work of course, but you really were a little bit limited. But, over the last few decades, and it's certainly been part of my career as I've seen this growth in the array of options that you have available for patients, and I think that drug-induced sleep endoscopy can help you choose from among them, because no single option really has emerged as the best procedure for everyone. In that we have different patients and the studies that are published, looking at individual procedures or potential combinations of procedures, they have results that are all over the place, to be honest.

You'll have the same procedure, or even combination of procedures, performed in a group of 30 patients in one study, another group of 30 to 50 patients in another study, and their results will be completely different. Really, one of the things that motivated me to go into sleep surgery in the first place, and certainly motivated me to think about examining drug-induced sleep endoscopy, was that we were pretty limited in terms of the evaluation techniques that we had to try to distill the reasons why some patients, individual patients, and even groups of patients respond very well to procedures or procedure combinations, whereas another group of patients would respond very poorly. I think it's not necessarily a surgeon having a good day or a bad day in terms of explaining why someone might respond well to a procedure and someone else might not. It has to do with underlying factors that are contributing to sleep apnea in the first place.

I think drug-induced sleep endoscopy is one of many evaluation techniques that have tried to sort this out, and the challenge has been that: Most of the evaluation techniques that are out there, you mentioned the Friedman staging, which I think is very helpful for picking out those patients often with the very large tonsils that might do very well with a specific procedure, but we have other things that haven't really shown to be useful guides for us when we're thinking about procedures, such as the [inaudible 00:06:53], such as just looking at sleep apnea severity. People, for example, have proposed that you take the Apnea-Hypopnea Index and well, if it's only mild-to-moderate sleep apnea, that's probably just the palate, so let's just give it a go, look at the palate, and if it's much worse sleep apnea,

moderate to severe, they probably need a combination of procedures, but that really hasn't panned out to be all that helpful in guiding selection of procedures or in predicting outcomes, to be honest.

Dr. John Marinelli:

Transitioning now a little bit more to the actual technique for drug-induced sleep endoscopy, how do we replicate sleep to get an accurate assessment of what patients' natural sleep is like?

Dr. Eric Kezirian:

The ideal thing would be: To do this during natural sleep. In fact, there were a couple of studies done in the late '70s and early '80s that did this, then actually it's been revisited with a couple of more recent studies, primarily in research settings, so not really in clinical settings for broad adoption. But, people trying to perform endoscopy while patients are naturally sleeping. That would really be nice if that were straightforward, but as you can imagine, it's difficult for people to fall asleep comfortably with a flexible scope in their nose, and then of course, if you're looking at different parts of the pharynx, you're moving the scope around, all those things can be fairly stimulating to patients if they're trying to sleep naturally. So, the idea behind drug-induced sleep endoscopy, which was first developed in Europe in the late '80s and into the early '90s, but described in 1991 was to give people some sedation and try to see if that can allow them to be in this state of sedation, drowsiness, while spontaneously breathing, but reproducing something close to a natural sleep in order for surgeon to visualize the area of obstruction.

In terms of getting at: What is a sedation? Where are we getting in terms of replicating sleep? It's a very difficult question to answer, because there's so many things that happen in sleep. Of course, there's neurologic changes, EEG patterns are very different during sleep versus wakefulness. But, I think from a surgical standpoint, what really matters is what's happening in the throat and what's happening with the decrease in muscle tone, what's called the loss of the wakefulness stimulus, and generalized decrease in muscle tone that occurs during sleep, especially during rapid eye movement sleep. So, the most detailed studies that have been done looking at sedation and reproducing changes in the pharynx that are similar to natural sleep and they're related to propofol. That's the medication I use when I perform drug-induced sleep endoscopy. It's probably the one that's used most commonly around the world, either on its own or sometimes in combination with low doses of midazolam. But, the idea behind propofol and the reason why I've found it more compelling to use it, is that the best work is a study done out of Australia showing that muscle tone and other measures of physiology in the pharynx are somewhat in the range of natural REM and non-REM sleep, so it's not natural sleep certainly.

Actually, the EEG activity is different, because propofol effects wave forms, so you are not getting the same wave forms that you get during natural sleep. But, I think the most important thing is what's happening in the pharynx, and this study was very detailed, only nine study subjects actually, but very detailed, showed that you had some of the same changes you see during natural sleep that are occurring with propofol sedation at what's called the transition to unconscious. Basically, people no longer responding to their name being called. Clinically, we see that during drug-induced sleep endoscopy, people are talking, a little bit disinhibited in the lighter degrees of sedation, but as they get a little bit more sedated, they lose consciousness, they drift off. They, of course, start snoring, typically they'll have a little bit of airway obstruction, again, having those changes that happen during natural sleep that we know occur because they've had a sleep study.

Dr. John Marinelli:

So, the doses you're talking about, that's typically lower than general anesthesia for normal surgery then.

Dr. Eric Kezirian:

Absolutely. So propofol, of course, it's used in many otolaryngology procedures. It's used, of course, in other areas as well, it's a commonly used medication. Different doses or different levels of sedation can be important for different kinds of procedures, and it turns out actually that the dose is very different for different patients. Factors like alcohol consumption can dramatically alter the dose that's required for someone to achieve a given level of sedation. So, that's why, what we typically do during the procedure itself is: I ask the anesthesiologist to start very low, in terms of the infusion rate, and gradually increasing it. It's a dialogue, I often give some signals to them to increase slowly the infusion rate to achieve that loss of consciousness slowly and gradually, rather than being in a big rush.

Dr. John Marinelli:

I've heard a little bit about a few other anesthetics, like ketamine or dexmedetomidine, any comments on those for this application?

Dr. Eric Kezirian:

I do have some, I'm not an expert in those at all. They have not been specifically studied for looking at the pharyngeal chambers. I think Dexmedetomidine has been examined, looking at some of the EEG wave forms, and it's a great medication for many uses, including in the intensive care unit. Because, what it does is produces wave forms that are actually very similar to natural sleep, so it's in many ways compelling that we have something that on EEG wave form looks similar to natural sleep, that's great. Problem is that, and this comes from the person who did the fundamental work on dexmedetomidine, the physician known as Mervyn Maze, who was the chair of anesthesiology when I was at UC San Francisco. He basically agreed with me in wondering whether dexmedetomidine would not have the decrease in muscle tone that you see with propofol and in that way would not mirror the changes that occur in natural sleep, and therefore may not be the best option for drug-induced sleep endoscopy.

Because, although the brain is having something similar to natural sleep, the pharynx is not. Ketamine, again, it's not well-studied. You got this dissociative anesthesia, which I don't really know that anyone knows exactly what it does in the pharynx. I think that these are two medications that a lot of anesthesiologists, that hear what we're doing with drug-induced sleep endoscopy, they get really excited and want to use these medications, because they're so useful in many anesthetic applications, but in terms of reproducing something in the pharynx that's close to natural sleep, I really don't think that they produce what we might be looking for in terms of understanding what's happening in the pharynx during natural sleep.

Dr. John Marinelli:

Just practically speaking, are you typically doing this in the OR?

Dr. Eric Kezirian:

I do this in the OR, it can be done in endoscopy suites, which are the two settings it's most commonly done in the United States. Have colleagues in Europe that do it, for example, in something equivalent to [inaudible 00:14:02]. It could be done number of settings, but it does require some monitoring. I use telemetry monitoring, EKG monitoring that's done, and of course the ability to administer supplemental oxygen if need be. I do it with someone from the anesthesia team. Basically, it's a very safe, knock on wood, but it's something that requires just having the standard precautions, just in case something [inaudible 00:14:29] would happen.

Dr. John Marinelli:

And building off the EKG comment and the supplemental oxygen, in terms of pre-procedural setup, any other considerations that you like to use prior to actually doing the endoscopy itself?

Dr. Eric Kezirian:

A few things come to mind, some are so silly that it's almost humorous, but you're going to be asking people to go to sleep with the assistance of sedation. So, I actually have people using the restroom in the preoperative area. Then, once we enter the room, we position patients in their most comfortable position. I often actually will examine people when they're on their side and we'll examine them supine. We keep the room quiet, turn the lights off, and make sure they have enough blankets to be warm enough, get the pillows somewhat similar to what they might have at home and have it be somewhat comfortable.

Of course, I'm going to be putting a telescope in their nose, but we use topical anesthesia in the nose. I actually found it extremely helpful, I didn't come up with this idea, but I give anticholinergic agent to [inaudible 00:15:34] their secretions. Something in the neighborhood of 0.2 to 0.4 milligrams, I use like a pyrrolate. Colleagues will sometimes use atropine. There definitely is some concern for some tachycardia. In younger, healthier patients, we're not as worried about that, in older patients we'll use lower doses. The idea is that: Decreasing the secretions will allow you to visualize the pharynx. There's a lot of connection between various sources of inflammation in the pharynx that can occur with untreated obstructive sleep apnea. They'll have more secretions than the typical patient and that can really interfere with what you're seeing during drug-induced sleep endoscopy and I think it's pretty important, very helpful to do that.

Speaker 3:

Talking a little bit now about, just in the procedure, how to systematically evaluate what you're looking at in terms of just regions of obstruction and making sure you don't miss anything. Can you just talk to us a little bit about how you think about just walking through the exam itself?

Dr. Eric Kezirian:

So, I don't take credit for this, I certainly, first of all, did not develop drug-induced sleep endoscopy. But, what I saw gradually in the first half of my career was that: There was not really a common language to describe what we were seeing. There were a few different ways of classifying what showed up as the pattern of obstruction during drug-induced sleep endoscopy, but it wasn't really something... similar to the TNM classification for cancer, that's used pretty widely. There needs to be some common language to tell someone what I saw during drug-induced sleep endoscopy, so with a couple of European colleagues, Nico de Vries and Vincent Hohenhorst, from Holland and Germany respectively, we develop what's been called the VOTE classification. Basically an acronym that refers to V for Villum or palate, O for oral pharynx lateral walls, including the tonsils, T for the tongue, and E for the epiglottitis.

The idea is that: These are the four main structures. Of course, each of them are composed of various tissue types, muscle, fat, other kinds of tissues, as well as different muscles even beyond that. So, they're not four things, but they're four structures that we would see and basically they can all contribute to airway obstruction. Many of them will have different potential degrees of obstruction, ranging from none, to partial airway obstruction, to complete or almost complete obstruction. They also could have different configurations for some of these structures. For example, the tongue pretty much just falls backwards, so that's going to be an anterior posterior configuration of collapse. The oral pharynx lateral walls, they will collapse on a side-to-side basis, so they're more this lateral collapse. But,

structures like the villum or the palate can have any one of anterior, posterior, lateral, or a combination that we've called concentric collapse. So, you can have this configuration and degree of obstruction related to these different structures summarized in the VOTE classification. I think people saw there was a real need for something like this, and it's the most commonly used classification scheme used around the world currently. It's not the only one out there, but it's one that's probably used most commonly.

Speaker 3:

You mentioned early on about some intraprocedural maneuvers we could do to bring out different elements or especially thinking about different procedures we can do, can you talk to us a little bit about some of those different maneuvers?

Dr. Eric Kezirian:

Again, these are things that I've not developed myself, but I think that where we want to, especially if we're going to the operating room solely for the purpose of drug-induced sleep endoscopy, we want to collect as much information as we can. So, two things come to mind as the real keys to learning more information than just: Sedate them and take a look. It's examining people in different body positions. I mentioned briefly that we usually start with people on their side, when we perform drug-induced sleep endoscopy [inaudible 00:19:42] achieve their desired level of sedation, then we just roll them on their back. So, we get an evaluation in both body positions, because positional sleep apnea is so common. What we've actually shown is that there are different mechanisms explaining the sleep apnea on the side versus supine.

In some people it makes a big difference in the severity of the sleep apnea, in some people it doesn't. But, often it makes a difference in terms of what structures are playing the role in physically blocking the airway, so I think that positional evaluation is pretty helpful. In addition, when it comes to a treatment option like an oral appliance, we will have the anesthesia team just provide a not a very aggressive jaw advancement that they do to rescue the airway, but advanced enough, in the neighborhood of five to eight millimeters, something like an oral appliance might offer to see at least qualitatively, what kind of airway opening is occurring. Some people the airway opens up dramatically with a little bit of advancement, some people you could advance the mandible across the room and it's not going to open the airway. I think that has really been useful. There are a couple of limited studies looking at those kinds of things, but they [inaudible 00:20:57] shown that it does seem to mimic the changes that occur with an oral appliance, and clinically I've certainly seen that [inaudible 00:21:03] we'll do that for most patients where that's a potential option for them.

Dr. John Marinelli:

Now that we've talked a bit about why we performed drug-induced sleep endoscopy and then the procedure itself, I just wanted to shift gears and talk a little bit about how the information that we get from this procedure influences treatment and eventually patient outcomes. Could you speak a little bit to how drug-induced sleep endoscopy currently influences our management strategies?

Dr. Eric Kezirian:

I remember back when I was a fellow in 2003, so we're talking dark ages now, I think I heard my first talk on drug-induced sleep endoscopy and I was fascinated. I had already seen, of course, the wide variation of surgical results that we mentioned earlier and I thought, "You know what? I'd be very curious to figure out how outcomes of procedures were associated with findings of this evaluation." [inaudible 00:21:54] a systematic way. And I laugh that it took me about 15 years, but we finally started to get a

better handle on this. Not that other people haven't tried, but one of the challenge has been: People have generally done single-center studies, which are always going to be a little bit limited on sample size, so it's going to make them difficult to tease out some of the nuances that are important in understanding how drug-induced sleep endoscopy findings would be associated with results of surgery.

Honestly, there weren't that many studies that were there. Not only were they single center, but they often included a wide variety of procedures. So, you'll have some where most people got palate surgery, then they maybe got another procedure, maybe they got another procedure. It didn't allow you just, because of the sample size, to be honest, it didn't allow you statistically to look at these things in more detail. So, we've now completed our second major international multi-center study looking at the association between drug-induced sleep endoscopy findings and treatment outcomes.

What we did was a little bit ambitious, I'm very proud of the work of so many people, I don't mean to take credit for this, but I did push things through and we've had some outstanding former fellows who are now becoming real leaders in sleep surgery, but basically looking at results. The first study, looking at results of upper airway procedures, whether that's palate surgery, tongue directed surgery, other kinds of procedures, and actually looking at prerecorded drug-induced sleep endoscopy videos and actually reviewing them with four surgeons in a way that we were blinded to the kind of surgery someone had, the results of surgery, and doing it, developing and having a plan for how we would come up with consensus evaluations, from what the drug-induced sleep endoscopy actually showed and getting real statisticians involved and looking at some of these things to figure out what findings in drug-induced sleep endoscopy are really important. First one being for upper airway surgery, the second one being for hypoglossal nerve stimulation. And really getting a better handle on how we maybe should use drug-induced sleep endoscopy and not, I guess, obsess on every little nuance of the VOTE classification, because honestly, some things are just more important than others.

The first study showed that what was bad was oral pharyngeal lateral wall related obstruction. If the sides of the throat are caving in, we don't really have great surgeries to treat that well. Maybe maxillomandibular advancement, maybe some of these newer palate procedures might offer some benefits. But, if you had either partial or complete obstruction related to oropharyngeal lateral walls, your odds were about half of getting a successful result of surgery. That was after controlling or adjusting for all different kinds of procedures and drug-induced sleep endoscopy findings. That was the most striking finding from that study. Also, if you had complete tongue-related obstruction, that seemed to be more difficult to get good results. So, some things that were maybe unfavorable findings. And it turns out that it may, even though we had about 275 study participants, a fairly large study, it may have been that if you had complete tongue-related obstruction, then you needed to do some of these procedures that really remove part of the tongue, some of the more involved tongue section procedures to get good results. But again, it really focusing us on some of the findings that seem to be most important from drug-induced sleep endoscopy.

Then, the second study was presented at the Academy meeting back in Fall 2019. We've literally just sent it off, but basically what we presented showed that complete oropharyngeal lateral wall obstruction also seemed to have poor outcomes. Partial oropharyngeal lateral wall obstruction actually still responded pretty well to hypoglossal stimulation, whereas complete oropharyngeal lateral wall obstruction did not respond as well. But, what it really responded well was tongue related obstruction. If you had a complete tongue related obstruction, because that was probably a big part of your airway obstruction, you actually did really well with hypoglossal stimulation. Because, as you can imagine, it moves the tongue forward. It was really something that, again, one of these things that only... It makes sense, that's the nice thing, but it took some of these pretty big studies from many people spending a ton of time getting things together and then reviewing all these videos in a blind way. That that's really kind of thing that I think gives us more of a foundation to say, "This is where it really can help improve

our procedure selection and especially improve our selection of patients, so some may not be as great for surgical candidates."

Dr. John Marinelli:

The last thing I wanted to just ask you is, if we just boil down clinically speaking: How would you just sum everything up in terms of advantages, as well as, we've obviously touched on some of these, but also just the disadvantages or the shortcomings of drug-induced sleep endoscopy. Where you think it maybe doesn't offer the information we need or where some of the missing links are. Could you just touch on that briefly?

Dr. Eric Kezirian:

The disadvantages: Number one, it takes time, as a surgeon, you're going to the operating room. Right now, the reimbursement isn't great, but that's not really a key thing. But, really just takes your time. So if you end up doing every single person, thinking about sleep surgery can be a real commitment, I guess. It's also expensive. While I mentioned the reimbursement for the surgeon isn't great, it's actually very expensive. Whether you're looking at hospital fee, anything done in the operating room is going to be very expensive and that's something you need to be mindful of. We have to be smart in how we spend our healthcare dollars, and I think that's important. As a surgeon and taking care of someone, I really would like to use all tests in some ways where it's going to be meaningful. So, I alluded to this before, but you want to use a test that is going to change [inaudible 00:27:50] management.

If someone comes in, for example, and they say, "I've had three friends that had soft palate surgery and they all did great, and that's what I want to have." And you look in and you say, "Well, the palate's probably playing a role. I'm not too sure about something else going on, but palate's probably playing a role." And that's really all they want to have done, at least as a first step, it's certainly going to change your management. You might do it at the same time you do a soft palate surgery, but you don't necessarily need to go to the operating room for a separate trip just to collect some information that's not necessarily going to be all that useful in changing what you do as a next step.

Also, people have these huge tonsils, again, you're probably not going to do things dramatically different than take out those tonsils. Tonsils themselves may interfere so much with the drug-induced sleep endoscopy that it may not be all that helpful in terms of giving you useful information. So, you might save the drug-induced sleep endoscopy for those people who don't achieve great results with the procedure that includes taking out those large tonsils. I used the analogy years ago at one of our international surgical sleep society meetings, that if you told me that wearing green shoes was associated with getting better results for sleep apnea surgery, I would tell people to wear green shoes. So, the idea that it has to be exactly like natural sleep, that's not as critical for me personally. The goal, of course, is to get something that's as close as we can reasonably, but I don't think we have to obsess on having everything exactly like natural sleep.

Certainly don't have the patience to sit there for hours on end for someone to try to fall asleep naturally. I think that's some of the disadvantages, of course, that it's not natural sleep may or may not matter. Because again, if the findings are associated with outcomes of treatment, that's really what matters, and I think that for a long time, we did not have reasonable evidence to indicate that. But, with a lot of people's hard work, I think that now we have a little bit more of an evidence basis, and it's something that's relatively scientifically rigorous, honestly, compared to most things that we do in [inaudible 00:29:48] medicine. It was done fairly carefully with the right kind of effort, I guess.

Dr. John Marinelli:

Well, Dr. Kezirian, I think this has been a really excellent discussion. Is there anything, before I transition to the summary of the episode, that you'd like to add based on what we've discussed?

Dr. Eric Kezirian:

The only thing I might add is that, if you're considering starting to do this in your patients, that the most important thing is to be patient. So, in terms of the sedation, telling the anesthesiologist not to be in a rush and not just give the patient the whole syringe full of propofol, just so they get to that level of sedation. Because, taking your time to allow people to get to that transition to unconscious is pretty important and will allow you to look at the airway. And when you have a chance to look at the airway, don't just look for 20 seconds, look for a few minutes. Because as we know, during sleep, natural sleep, there are different things that happen during different stages. Not that we're getting different stages of sleep, but there are some parts of the night, better and worse. And the same is true under sedation.

So, you want to make sure you're getting a pretty consistent pattern of what's causing their airway obstruction. Not that people have the same pattern all night, every night, but we want to get something that's a pretty good representation of what might be occurring. So, if it's a few minutes on their side, a few minutes on their back. Maybe not a few minutes, but at least a certain chunk of time with a mandible advancement, taking your time to do it. Because, it's costing the patient quite a bit of money, so you might as well get really useful information. That requires just taking your time and doing the evaluation.

Dr. John Marinelli:

So, in summary of today's episode: In patients with obstructive sleep apnea who cannot tolerate medical therapy with C-PAP or patients with snoring that desire surgical management, drug-induced sleep endoscopy is used to help characterize the nature of patient's disease. With the recognition that really no two patients with OSA are the same, and that the patterns of obstruction may vary significantly from patient to patient, so this helps to address that reality. Practically speaking, the goal of drug-induced sleep endoscopy is to provide a dynamic assessment of patient's sleep, and therefore the intent is to replicate sleep to a reasonable degree through sedation, really at this transition point to unconsciousness. During the procedure itself, you want to systematically evaluate patients' regions of collapse, for which the VOTE classification provides significant utility and is widely used. The VOTE classification stands for: V Villum, O oral pharynx, T tongue, and E epiglottitis. Lastly, drug-induced sleep endoscopy, the information you get really helps to guide future management among the myriad of choices that you have and picking which ones might be best for the patient in front of you. Dr. Kezirian, anything you'd like to add to the summary?

Dr. Eric Kezirian:

Just that it's been great to join you today and I really appreciate the chance to share with people that have an interest in this area.

Dr. John Marinelli:

We really appreciate your time, so thank you. All right. I will close now this episode with just a few questions. So question number one: Overarchingly, why do we perform drug-induced sleep endoscopy? So, there's a wide variety of clinical phenotypes and the underlying mechanisms of obstruction in patients with obstructive sleep apnea can vary considerably, so drug-induced sleep endoscopy really helps to characterize individual patient's disorder during a dynamic assessment of their obstruction patterns when considering surgical treatment for those who are unable to tolerate C-PAP.

Next question: How is normal sleep replicated during drug-induced sleep endoscopy? Normal sleep is replicated really through this idea of the transition to unconsciousness, which is identified during the procedure when the patients stop responding to verbal stimuli. The anesthetic regimen itself varies often from institution to institution, but propofol has been a commonly studied anesthetic that can be administered either in boluses, target controlled infusion, or continued as continuous rates at about half to maybe two thirds of a typical general anesthetic rate. And recall also, as we mentioned, that Dexmedetomidine likely has a limitation of not creating the same physiologic [inaudible 00:34:10] of the upper airway when used for this purpose.

Lastly: When performing drug-induced sleep endoscopy, what classification system is widely used to systematically evaluate regions of airway collapse? The correct answer here is of course the VOTE classification, which stands for V, villum, which includes the palate. O, oropharynx, includes the lateral wall and tonsils. T, tongue base or tongue. And E is epiglottitis. And recall, it's also important to consider the configuration of the collapse, being either anterior, posterior, lateral, or concentric, depending on the region you're discussing, and as well the degree of collapse. So, whether there's no obstruction, partial obstruction, near complete obstruction, or complete obstruction. Well, that'll wrap things up for today's episode. Thanks so much for joining us and we'll catch you next time.