

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 laryngologist, Dr. Greg Dion to discuss laryngeal trauma. Dr. Dion, thank you for being here today,

Dr. Greg Dion:

Dr. Marinelli, thank you for having me. I'm very excited.

Dr. John Marinelli:

Just to start this episode off, I just wanted to ask you a little bit about how common laryngeal trauma is and how does it manifest? Just because I don't see it all that often, so I just want to start with that.

Dr. Greg Dion:

Yeah, absolutely. Laryngeal trauma obviously is not the most common thankfully trauma we see. And albeit rare, it can be very life threatening, so it's important to understand how it can happen. Traditionally, we think of it in the setting of multi-trauma, so motor vehicle collisions with multi injuries, but there are other ways you can have this. For example, a great way that people can get a laryngeal trauma is a lacrosse ball to the neck.

Dr. Greg Dion:

Unlike hockey players who have a special neck guard, lacrosse helmet comes down, it doesn't cover the neck. So if your neck is extended when the ball comes, you can take a shot right there to the neck and cause an injury. So you can see it in ways like that. Then other places where your neck is extended. For example, say you're pushing a car in ice to help someone out and you slip on the ice and you extend your head and hit your neck on the bumper. I've seen that result in laryngeal trauma.

Dr. Greg Dion:

Those are the general kinds of injuries that might precipitate a laryngeal trauma injury.

Dr. John Marinelli:

And symptomatically, how do patients typically present?

Dr. Greg Dion:

There's a couple of things you might see a lot of this depends on the overall setting in which the trauma occurred, but if the patient comes in, they'll frequently be hoarse or just phonic. That might be a raspy voice or a really breathy voice. You might notice some crepitus that they may actually have some difficulty breathing, some stridor. They may come in with less particular complaints or they could have like a cough or trouble swallowing. All of this can be related.

Dr. Greg Dion:

Some of the things you might feel would be tenderness to the neck, there might be some evidence of an underlying expanding hematoma. You might cough up some blood or have a lot of tenderness to the region just above the clavicles.

Dr. John Marinelli:

How does age play into this?

Dr. Greg Dion:

This is really fascinating. It turns out that the younger you are, the less likely you are to suffer a laryngeal trauma and that's for two reasons. In the very young age, you'll notice that the larynx actually sits higher in the neck as compared to an adult. So just by the orientation of the anatomy, young children and infants are generally protected from laryngeal trauma just by the location of the larynx in the neck much, much higher.

Dr. Greg Dion:

As we age, that drops down, and so your adolescent and young adult larynx is still pretty elastic and the cartilage has a lot of give and play to it. Remember that unlike a lot of other bony structures, the larynx is freestanding and hanging, supported above and below by the trachea and supraglottic structures in the neck. So as you age, of course, that calcifies, and that calcification makes it more rigid and more likely to fracture.

Dr. Greg Dion:

So you generally see these traumas that are non penetrating or non-severe in older people who have had an injury.

Dr. John Marinelli:

Moving on to pathophysiology, I know the breadth of this topic, it encompasses a lot of different types of injuries and whatnot. But could you give a brief overview of just the different types of injuries and pathophysiologically what is going on here?

Dr. Greg Dion:

Yeah. There are quite a few structures that can be injured in a laryngeal trauma. I think that will also represent itself in how those symptoms manifest to a patient presenting. Some of the things that might happen, you might have a nerve injury, so that would include your recurrent laryngeal nerve, and that might be injured from a number of reasons. You may have stab to the neck, so a machete injury could sever a nerve. That's not optimal and you'd have motion abnormalities because of that.

Dr. Greg Dion:

If you end up with a superior laryngeal nerve injury, then you may have dysphasia or pitch restriction in the patient's voice, and they may complain of inability to raise or lower their pitch. That might be one of your initial findings. You might also end up with compression, so if there's a hematoma, or edema, or swelling, that might compress the nerve. Then that compression would result in an equivocal nerve injury where you might have motion unilateral or bilateral abnormalities.

Dr. Greg Dion:

In some fractures, especially open fractures of the larynx, you could have endolaryngeal injuries. So if your framework is disrupted, that might transition and translate all the way through to the airway with disruption of the mucosa, or you may have submucosal hematomas or edema. Depending upon the type of injury, one way to look at it is someone who hits their steering wheel with their neck extended could

have arytenoid cartilage subluxation or dislocation. That might present as a fixed cord, so that type of injury could cause a subluxation or dislocation.

Dr. Greg Dion:

You can injure the cricoarytenoid joint with or without damage to the recurrent laryngeal nerve. Your hyoid bone just above your larynx could end up being fractured in a hangman's fracture type clothesline injury, or you might even have a cricoid fracture. And that's important to recognize because of its increased risk of airway compromise. Then as things progressing around the severity, you could end up with a cricotracheal separation, basically where if unrecognized, you put yourself at a real airway risk in terms of the trachea retreating into the chest and it becoming problematic to ventilate that patient or oxygenate them.

Dr. Greg Dion:

This might happen in A, most likely a penetrating neck injury, be it from a projectile like a bullet or something sharp like a knife or a machete. Or it could actually additionally happen in some situations from a blunt injury. Those are the things to think about. Then as we think about what's around there, you really run the risk of having pharyngoesophageal tear or pharyngoesophageal injury.

Dr. Greg Dion:

So when we've put this together in terms of a differential, some of those signs and symptoms will lead us down exploring a variety of those different things that could happen, just by the number of structures that are in the area and the impact they have on vital functions such as breathing, speaking, swallowing. They're your precarious spot in the neck between major blood vessels and nerves.

Dr. John Marinelli:

As we transition to workup, if you're going to see the patient, what are the key features on physical exam and whatnot that you like to look for?

Dr. Greg Dion:

Workup is really interesting. I think when we approach it as when you're going to see the patient, it turns out that trauma is very multidisciplinary, which in our case is great because an otolaryngologist isn't in the trauma bay every time a patient comes in with laryngeal trauma. And as a result of that, you may not be there initially and maybe called down. But in the event that it's not an emergency, you go down and see the patient and really most importantly is, your sense of what's going on as you walk in, it plays a huge role.

Dr. Greg Dion:

Is the patient sitting up? Are they looking at you? Do they look like they're in distress? If you see a patient tripodding or gasping for breath, that's obviously going to change your approach quite a bit. Another thing you want to think about is when you introduce yourself, which obviously we all do, how does that patient respond? Do they talk with a hoarse voice, a breathy voice? Do they have a pressed phonation? Can they get a sentence out without having to take a breath?

Dr. Greg Dion:

Those are the things that we often overlook in our haste. We get called, everyone's ear's perk up, you're like, "Ooh, laryngeal trauma." There's some patient that got a baseball bat to the neck and you're skipping down to OR and down to the ER, excited to see what's coming in that you can help with. But the reality is that some of those simple things are going to give you the most information.

Dr. Greg Dion:

So all of this happens before you've laid your hand on the patient or taken a complete history. And that's really important because I think in terms of understanding what's going on, getting a sense their natural breathing pattern when you see them, are they comfortable and what does their voice sound like? That gives you a really good hint as to where you're going to go next and focusing your physical exam on making some smart choices, moving ahead.

Dr. Greg Dion:

Obviously, you're going to do a complete head and neck physical exam. So here, you're going to be specifically looking for any lacerations, and you might have some of this information if the patient's awake from the mechanism of injury. So was this something sharp? Did someone attack them with a bobby pin? Or was it like a blunt thing like a baseball bat or something to the neck? That gives you an understanding of what to look for you.

Dr. Greg Dion:

You want to actually put your hands on the neck and not just feel for crepitus, that subcutaneous emphysema that's going to give you a sense of that there's some air in the neck. But also you want to feel that larynx elevate and move anteriorly when the patient swallows. You want to gently hold the larynx and have them swallow and see, is that really tender? Is there an issue with that? Do I see anything that looks like it could be any kind of hematoma?

Dr. Greg Dion:

All of that information before you've got out any of your toys, I think is really important to set the stage of what are you thinking of, what are you looking at. Now, obviously, and this is all idealistic because this is a stable patient that you're seeing. In the setting of an unstable patient, obviously, your decision and your treatment comes sooner in the management. But this gives you your first sense of what to do.

Dr. John Marinelli:

In terms of flexible laryngoscopy, how do you think about using that in this setting?

Dr. Greg Dion:

That is a great question. Although we're all skilled in flexible laryngoscopy, we need to consider our situational awareness. Understanding what the patient's situation is, is important because if we're looking at a patient who is clearly doesn't appear very stable, maybe has some air hunger, or concern for some kind of a mass in the neck, or a hematoma, or something, then it's important to consider what might happen if we rush a laryngoscopy.

Dr. Greg Dion:

The reality is that a young resident running down to the ER excitedly with a Flexscope might actually precipitate more problems in that immediate moment, so a thoughtful decision needs to be made. If the

patient's stable, of course, it's invaluable tool because it allows us to visualize the end of larynx, understand what the vocal fold mobility is. Is there a fixation? Is there a vocal fold immobility? Is it arytenoid dislocated?

Dr. Greg Dion:

Are there endolaryngeal lacerations? Is there airway [Peyton 00:11:52]? Is there edema, hematoma? A lot of those things you lose if the patient gets intubated or has another airway and you can't have the patient speak for you.

Dr. Greg Dion:

With that said, it probably needs to be done by one of the more experienced people in the room for twofold. One, to make sure you're efficient in getting it done, but also having a patient cough or gag who's already got some crepitus. You don't want to see that develop into a pneumothorax.

Dr. Greg Dion:

When you consider all of these things, if a patient has a potential cricotracheal separation or something, it might be more appropriate to do that flexible laryngoscopy in the operating room setting when you're getting prepared to do some kind of treatment options. That's really important and that's where you decide how are you going to work this airway up? This is probably a good spot per se, to fit that in and say, "How are we working up that airway?"

Dr. Greg Dion:

And if you think that that airway is not stable, then some decisions need to be made. One is, what do we do about imaging, but also I can the patient go to the operating room? Do we need an alternative airway? Do we need an intubation? That conversation, at least in your head needs to be happening.

Dr. John Marinelli:

You started to mention imaging there, what do you like to do for that?

Dr. Greg Dion:

Imaging can be really invaluable in a laryngeal trauma case. Interestingly enough, a lot of these patients, not a lot, but just about all of them come in with any head and neck trauma, go through this Pan Scan. Generally speaking, that's going to be a CT scan with contrast. But just like a lot of small structures that we might find and say like the temporal bone or sinuses, we really need high resolution to illustrate what's going on in the laryngotracheal complex.

Dr. Greg Dion:

That's because if we look back to what we were saying earlier about the slow ossification of that cartilage. It doesn't show up well all the time in younger individuals, so noticing that fracture might be problematic. I can tell you that more than once I've seen a patient actually be told that they didn't have any issues with their larynx, only to find out when we were consulted for a voice issue that in fact there was a full longitudinal fracture of the thyroid cartilage that had just been missed because it's so easy to oversee.

Dr. Greg Dion:

So if at all possible, as it turns out, many of the trauma centers will record the scopes in a very high resolution, but then second two data storage situations, only record them in the imaging systems at a lower resolution. So you really want to get as high resolution as you can of the larynx itself to get a sense of what that looks like. Because you can even oftentimes see what's going on with not only your thyroid cartilage, but your cricoid and your arytenoid.

Dr. Greg Dion:

And that's really important because if you're seeing cricoid fracture or specific fractures in the larynx, it helps you do some operative planning. But imaging really isn't restricted only to understanding what's going on with the framework of the larynx. Swallow plays a huge role here because one of the really devastating concerns is, is there a pharyngoesophageal tear or leak? So in this case, you're thinking about some kind of a swallow assessment.

Dr. Greg Dion:

And that leads us down the pathway of an esophagram. So for pharyngoesophageal tears, you're generally going to start with a Gastrografin swallow study. That's because Gastrografin is far less reactive in the neck as compared to barium. Barium is highly reactive in the neck and can cause significant trouble for patients and actually precipitate a new set of problems that you nor the patient wanted to encounter.

Dr. Greg Dion:

Along that lines, the downsides to Gastrografin is it doesn't quite show up as well as barium, is not as bright just due to its radiopacity. If you do a Gastrografin swallow, that appears to have no leak. It's really important to follow that up with a barium sulfate so that you can understand what's going on. This minimizes the risk of any kind of barium-induced mediastinitis and also allows you to fully illustrate what's going on.

Dr. Greg Dion:

Now, as we get into the 2020s here, one of the great imaging modalities is actually a CT esophagram. This is a little more tricky and a skilled radiology tech and radiologist can really help you with this. And in this case, what they do is while capturing a CT scan, they actually have the patient swallow the barium and do the esophagram at the same time. The beauty of this is that now you're able to visualize the radiopaque material in the esophagus in a CT scan. It gives you a really good resolution of what's going on.

Dr. Greg Dion:

Now, as you might imagine, sometimes timing that can be tricky and even in a relatively stable patient, we can get a CT with contrast or even a CTA, which allows us... The CT angiogram is gonna allow us to evaluate the large vessels in the neck. That can be done even in moderately stable patients, but to do some of these more nuanced exams such as an esophagram or a CT esophagram, you're going to look for a patient who's probably not as acutely sick.

Dr. John Marinelli:

As we transitioned from workup to treatment, I just wanted to ask you briefly about the neck zones as it relates to head neck trauma. Can you tell us a little bit about that?

Dr. Greg Dion:

Yeah. The neck zones are important. As you can imagine, the larynx really resides in only one zone. But understanding that in terms of penetrating neck trauma is really important. The neck is generally up into three zones and they're working from bottom to top. So we first think about the lower neck zone one. And so in there, you're looking down from below the cricoid cartilage down to the mediastinum and the chest.

Dr. Greg Dion:

And so you've got the carotids, the large arteries, the lungs trachea, esophagus, thoracic duct, and all those things are at risk. You move into zone two, which is well known for its traditional historical need to be explored for penetrating injuries. That's where our larynx resides as well as the contribution of the esophagus there, the recurrent laryngeal nerves, vagus nerves, all fit in that midline area and extends up to the mandible.

Dr. Greg Dion:

So the third zone of the neck is above that mandible, and that's where you have your vertebral arteries, your jug, your parotid, submandibular glands. That's an area where that's harder to get to, so that's one of the reasons that was always been broken up is one of the places you're going to go to is balloon angiography to treat it. But when we talk about laryngeal trauma, we've put ourselves squarely in zone two be it for blunt or penetrating trauma.

Dr. John Marinelli:

In regards to laryngeal trauma in terms of classification or grading systems, is there anything you like to use for that?

Dr. Greg Dion:

Yeah. Years ago, and it's been added on. Actually I think they developed at UT Southwestern before moving on was the Schaefer Affirming Classification. So this is a progressive classification that numbers from one to five. Just like anything, it gives you a sense. It's a great thing to have as you reported in a notch or call an upper level and say, "I have a grade two or a grade three injury."

Dr. Greg Dion:

But the reality is we go through, you'll see that just like anything in life, there tends to be a little more nuances than are illustrated in a simple grading scale. But for the purposes of something to work from, it's just a good starting spot. So if we start a stage one, we're talking about looking at the patient, there's no obvious fractures. There might be a small hematoma inside the larynx in the laryngeal mucosa. That would be what's considered the most mild injury.

Dr. Greg Dion:

Moving on, we'll get to stage two. As you can imagine, this is a progressive stage. In stage two, we have our hematoma, or edema, and there might be small breaks in the mucosa without cartilage exposure. So you might see some mucosal tissues, explore GSP, or other tissues, but you haven't exposed in any cartilage. When you take time to evaluate the CT scan, you'll find most likely a nondisplaced fracture.

Dr. Greg Dion:

But this is where things get interesting because you can envision that you actually open a CT scan and find that you've got a fracture, but you don't have any tears. And so how that really fits in it's where it gets a little more nuanced. But then moving on, you could have stage three. Stage three is as we progress, so you take that hematoma. Now it's more widespread, so you have severe edema, you've got mucosal tears, cartilage exposure under laryngoscopy evaluation.

Dr. Greg Dion:

Then when you're talking about movement, and this goes into being able to assess the patient before they're taken to the operating room, you're talking about vocal fold immobility or vocal fold fixation, which is important if you're considering like arytenoid subluxation. Now, interestingly again, why I say this becomes more nuance is, you could actually have vocal fold immobility or reduced mobility without any of these mucosal injuries. So that's an important clarification.

Dr. Greg Dion:

Moving on to stage four as we progress up. Now you're looking at all the things that we've already discussed with more than two sites and larynx involved, and more severe lacerations to the mucosa. That would be stage four. Then ultimately, stage five is total separation of the larynx from the trachea, so laryngotracheal separation is stage five.

Dr. Greg Dion:

Traditionally, that five stage classification system gives you a starting point, but as I mentioned, some of those things crossover and just like anything in life, it's not all-encompassing. But it's a great way to start considering where you fall on those lines

Dr. John Marinelli:

And transitioning to treatment now, I think overarchingly, we can break it down into conservative and surgical management. Can we just start with conservative or medical management, which patients fit into that category and what that looks like?

Dr. Greg Dion:

Yeah, this is great and a little challenging to break up, but I like the way that we're dividing it up here. If we're just start off and talk about conservative of management, you can envision that these are obviously not the unstable patients. These really fall into two different categories. One would be the patient that probably has an isolated laryngeal injury. Spinning back to where we started, this could be that patient who was pushing grandma's car out of the snow, slipped, hit the back of their neck on the hood.

Dr. Greg Dion:

Now has a hoarse voice, you see them in the ED. They come to your clinic, you do a videostroboscopy or a flexible laryngoscopy. And in that exam, you find like a vocal fold hemorrhage or maybe minor reduction in vocal fold mobility. In this case, you've done your CT scan and for the sake of discussion here, there's no fracture.

Dr. Greg Dion:



Clearly, this person has an injury, and so going back, this would be our grade one. In this case, this is something or somebody you're going to want to watch, and so that person needs to be observed. This is really isolated. This option is isolated to small soft tissue injuries like hematoma with an overarching stability to their larynx, without any lacerations or laryngeal injuries of which you're worried about. Edema, laryngeal compromise or poor wound healing.

Dr. Greg Dion:

It also opens a controversial topic is, in a single nondisplaced fracture. What might have happened is, you look in the CT scan and you get a nice, fine cut, and you're looking through, and you scope the patient, and they've got a hematoma, but they appear to have normal motion. But now you see just an isolated laryngeal fracture. Or perhaps there isn't even a hematoma and you find an isolated laryngeal fracture. What do you do?

Dr. Greg Dion:

There's an argument to be made and a very real one that it's more than adequate to just do observation in that patient. Now, if their voice is not good, so if they're just phonic and there's motion abnormalities, that might be a spot where you're going to say, "We might need to intervene here." But if their voice is normal and they don't have a hematoma, then you could watch them.

Dr. Greg Dion:

If you see a hematoma and some voice abnormalities but what appears to be normal motion, again, you have a good position to say, "This might be a patient that I want to watch." Now, in general, I think all these patients should be admitted. So you're seeing that person that has clear signs of a laryngeal trauma, so you either find a fracture with no other findings or you find edema, hematoma or like a hemorrhage without a fracture.

Dr. Greg Dion:

They really should be monitored inpatient for 24 hours, just to make sure you're not missing any other fracture or progressive injury. So if they have edema and swelling and they're slowly getting compression of their nerves, they might end up with unilateral or bilateral vocal fold immobility. This is where clinical judgment plays a huge role, so as an inpatient, you might keep this patient depending upon your institution and concern level as a step down patient with a continuous pulse ox monitoring.

Dr. Greg Dion:

Obviously keep them NPO. In some situations you might be more concerned in terms of their edema level, and so you might want that patient moved into a higher level of care for closer observation. You're going to want to keep that head of bed elevated. This seems silly, but it's often overlooked, and do you want that head up so you can overall reduce edema. I think you need an airway plan, and we can talk a little bit more about that.

Dr. Greg Dion:

But is this so severe that you're thinking you need to tray kit at bedside? If that's what you're thinking, then maybe you should slide that patient into potential surgical management, even if it's just for a direct laryngoscopy. But you do need to be thinking about airway adjuncts and is this patient intubatable? Could you intubate the patient at bedside? Could you use Heliox? What would be your temporizing

solutions so that you're not doing some kind of emergent airway at the bedside? because that's not good for anyone.

Dr. Greg Dion:

Then there's consideration for voice rest and I always found this interesting because as really situational dependent, if you're a public speaker and you come in and you've got a vocal fold hemorrhage, yeah, you're on voice rest. But if maybe you have some small decrease in vocal fold mobility, the literature really doesn't say if you should be on complete voice rest or not. That's going to be largely left up to each of those individual situations.

Dr. Greg Dion:

And really like, again, clinical judgment, without mucosal tears, I think moderate voice use is okay. The argument again is if we're talking about vocal fold hemorrhage, those patients are often kept on voice rest so we don't worsen their voice. But maybe mild decrease in mobility, it might be okay to continue to have them speaking.

Dr. Greg Dion:

Then other treatments that you're going to provide these patients, in almost all cases and very few exceptions, you're going to be giving these patients corticosteroids. The reason is to reduce the edema. These injuries, one of the feared complications is that loss of the airway. So probably the best example of that is in an inhalation injury. This is classically described as someone has a heat inhalation injury, gets scoped.

Dr. Greg Dion:

There's certainly the nose, certainly airway, some edema, but it's not bad. Then six hours later, there's no airway, no one can get. It's an emergency airway situation. So all laryngeal trauma obviously doesn't progress that way, but the patient for which there's no vessel injury or indication for surgery, you're going to watch conservatively, the steroids play a number of roles.

Dr. Greg Dion:

We know they play a role in altering wound healing and then an optimal fashion laryngotracheal complex, but also they help reduce any of that edema. There's this question of antibiotics. If there's really no injury, no fracture, and there's plus minus role for giving a patient a broad spectrum antibiotics is where as we're learning more in medicine and more and more information comes out, there's obviously risks to being on antibiotics.

Dr. Greg Dion:

So in the case of no crepitus, and no fracture and a hemorrhage, then probably no antibiotics. But if you're talking about observing a nondisplaced fracture, you could make an argument potentially for an antibiotic in the right patient.

Dr. Greg Dion:

Then finally, everyone's favorite topic is antireflux medications, which get thrown at everything. I think probably the best data on this would be looking at infants that have supraglottic collapse. Those infants

are to have improved outcomes with antireflux meds and we know that they can be useful in the airway issues

Dr. Greg Dion:

. So I think that if you think there's any mucosal disruption or the patient is symptomatic from everything, the antireflux meds wouldn't hurt. But I certainly would consider not sending patients home on months and months to them without having... Unless they have underlying reflux.

Dr. Greg Dion:

The other thing that that gets observed and gets classified under the umbrella of laryngeal trauma is, if we don't see a fracture and maybe there's no other injury, but there's some air in the neck and the only finding of physical exam was crepitus, then those patients, I tend to watch, keep them NPO plus or minus on all the medications. Generally, you give them steroids to help any local inflammation from the air in the neck. But again, with a very low threshold to pursue something.

Dr. Greg Dion:

But that's a more complicated, a little off topic because those patients might have an injury in their pharynx or something, and that has just let a bunch of air in. But those are really the extent of patients that you can just completely manage in a conservative observation type manner.

Dr. John Marinelli:

Just transition, obviously with surgical management, there's a number of different things we could talk about, but could you touch on just the key highlights surrounding when do we operate and what does that typically look like?

Dr. Greg Dion:

Yeah, of course. Surgical management, I think really takes a couple of different forms. I think one of the things to consider is the arc of the airway. It's not always just find and fix, we'll get to that. That's a different situation, but one of them is the uncertain airway. If we scroll back to what we were talking about earlier, we said, "What is the status of the airway?"

Dr. Greg Dion:

The otolaryngologist can play a key role in establishing and safely establishing the airway. And so this might involve, which I find very helpful is really close communication with anesthesia saying, "Hey, we did the CT scan, the CTA. It looks like the vessels are intact, but the patient is clearly short of breath. It looks like flexible laryngoscopy revealed there's some mucosal damage here. We needed to be careful with this airway."

Dr. Greg Dion:

So you're going to take that airway to the operating room. This is where communication, and your multidisciplinary team, and your skill really comes in. Because what you don't want to do is be saying, "Okay, this person is getting like a fiber optic intubation and someone's trying to shove a tube through from above. And the patient's coughing and they're causing a laryngotracheal separation or doing significant more damage to the endolarynx."

Dr. Greg Dion:

That's not good for anyone. It's going to complicate your repair, and it's also going to make the overall situation worse. So you have a couple of different approaches. If you're not so concerned about the airway and you're thinking more along the lines of mucosal tears and injury, this might be an opportunity where you yourself intubate with a small tube. You do the intubation to make sure that you're not damaging any of the endolaryngeal structures.

Dr. Greg Dion:

It might also be a time in a more severe injury where you have that discussion with the patient or their family and anesthesia team upfront and say, "This is a patient who's probably should just get the awake trach upfront. This way, we're not instrumenting the larynx. We're careful about doing this." You might consider doing a rigid broncs so that you cross any potential laryngotracheal separation so that you can ventilate into the lungs.

Dr. Greg Dion:

This kind of approach gives you a lot of options. It lets you see the larynx before it's been further instrumented and understand what's going on. In terms of, what do we have to do today? I think that kind of approach, you're going to really focus on those patients that have showed up and show that they're not great candidates to wait. So penetrating neck trauma, even without CTA findings often warrants a repair that same day.

Dr. Greg Dion:

That's your opportunity as the airway expert in the hospital to step in and say, "Probably recommend and work with your multidisciplinary team to best secure the airway in the safest manner possible." So you can make the next step in the repair. I think those are the obvious patients. In fact, as an otolaryngologist, many will find that they get called to the operating room after general surgery has, or trauma surgery has explored the neck because the patient showed up with a light bulb sticking out their neck because someone jabbed them in the neck with it.

Dr. Greg Dion:

And so obviously somebody went in there to control some bleeding, and then you show up and then, the patient's already got a breathing tube in. Downsides in that situation is you don't know what the airway looked like before the patient was intubated. You don't know what the vocal fold mobility was. And so you're left a little bit in the dark on that. But that being said, those are the patients that declare their own situation as you get back there.

Dr. Greg Dion:

Even nowadays in 2020, a lot of those patients have a CTA and a CT scan that you can review and you just build off of what you get. We live in a world where we're not in a silo and those patients get treated by multiple people. So regardless if it was the perfect idea or not, the patient's been intubated or somebody put trach in or something happened and you're coming in. You're going to just use that as your foundation and build from there.

Dr. Greg Dion:

That's the urgent patient, and this is a great spot to transition into planning an open reduction repair because one of two things is really going to happen. Either you're going to get called in to either help do the intubation and laryngeal evaluation, followed by a repair, or you're going to come upon a patient who's intubated and trauma surgery wants your help. Or probably the most common I think is a patient who's been stabilized in the ICU and you have noticed some fractures on a CT scan and now you're planning your approach.

Dr. Greg Dion:

This again is really broad, but I think we can break it down into some simple things and then work our way up from there. Most importantly, when we think about longterm outcomes is we're really trying to preserve airway function and voice function. So if we see a bunch of mucosal lacerations or damages, these need to be repaired. So you're going to think about what your individual skillset and tools are and the extent of the injury and make your decisions from there.

Dr. Greg Dion:

If you look at a patient who has a minor laceration, you've got a great equipment set up and you have endolaryngeal instruments, you think you can repair it endolaryngeally, and there's no other issues you need to address. By all means, that's a great approach. More extensive injuries to the mucosa of the larynx might require a midline thyroidectomy or an infrahyoid laryngectomy. That allows you a more easier approach to repair those mucosal injuries provided that you're able to get everything back together and properly put in position.

Dr. Greg Dion:

Because ultimately what we want to do is prevent longterm scarring laryngotracheal stenosis, and so these will let us do that. There are plenty of other things that will come up, and so we're still on the endolarynx and you might need to do in arytenoid repositioning maneuver in the uncommon scenario of an arytenoid dislocation.

Dr. Greg Dion:

Then you have to think about "stenting or keels" to the airway. So a lot of these endolaryngeal repairs you guess are going to require an alternative airway. So, that patient probably has a tracheotomy or a T Tube for a period of time, and that T Tube might extend through the cords or not. So if you've gone in and done your repair, you need to decide how you're going to maintain the formation and laryngeal framework. So there's a lot of options there.

Dr. Greg Dion:

And in and of itself that laryngotracheal repair, we could go on for hours to my happiness to discuss that. But the reality is you could use a Montgomery Laryngeal Stent, you can put a T Tube through the framework for stabilization. You could use a Gore-Tex or Silastic keel to maintain the position of the anterior commissure. All those are options and I think for the purposes of our discussion today, that just gives you some sense of how you might repair those.

Dr. Greg Dion:

And all of that is your endolaryngeal issues. Moving outside of that, I think we really need to mention what do we do about the framework? Framework surgery is great, so we can easily go into the neck and repair the thyroid cartilage or cricoid cartilage. But it does pose some unique issues. So AV anatomy can

be a little bit tricky or complex to fit or adequately fit plates to or wires. So this goes into, how do you fixate it?

Dr. Greg Dion:

You have a number of options and again, a lot of this is left to A, what's available in your facility? B, how adept and nimble are you with your equipment and what are you most comfortable with? So the full range of options would be just using sutures to try to suture things back together like large prolene sutures suture to suture back together the cricoid or laryngeal cartilage.

Dr. Greg Dion:

As you can imagine, because they're not three-dimensionally fixated, is easy for them to slide and sutures are slippery. So some people use wires and try to wire it together, but again, that leaves you with those same issues and you can cheese wire through the soft cartilage and younger individuals. So there's a great role for mini-plates, and mini-plates have been used elsewhere in the mid phase and neurosurgery, we're really adept as otolaryngologists at the use of mini-plates.

Dr. Greg Dion:

Yet those pose in and of themselves some issues, and so those issues generally are, "How do I get the screws to stay in the cartilage?" And that can be a frustrating experience for a young resident or faculty to say the least. So I advocate for really a hybrid approach, and so I like to take a mini-plate, and then instead of putting a screw through the individual holes, you can use either a wire or you could use a suture. Or my favorite is they make actually sutures that have wire on the end of them and you can put that through.

Dr. Greg Dion:

So now you're wiring the plate into position, it gives you that 3D stability. So if you're just looking at repairing laryngeal framework and it's stable, and there's not much edema, you don't necessarily have to have an alternative airway trach or what have you, but those are some really good options. Then that addresses any of the laryngeal framework issues. And as you could imagine, the cricoid, the thyroid cartilage and the pattern or which plate you use have to be adapted to the individual situation, but that's your approach there.

Dr. Greg Dion:

Then finally is penetrating trauma with concern for recurrent laryngeal nerve injury. This is always tricky because a lot of times in these situations, you haven't had a chance to do any kind of laryngeal EMG. One of the things that might happen is if you come upon a patient who was otherwise stable and had a recurrent laryngeal nerve seems to be out on your flexible endoscopy. Is that because of the patient was intubated for some other procedure or because of edema?

Dr. Greg Dion:

Then you'd have to consider the role for a laryngeal EMG to understand that. If it's a penetrating trauma and you're there and you had a chance to scope the patient and saw that it was out, then there's a role. Why don't you go find the nerve? The risk always though is, if you're digging around looking for the nerve, are you going to be causing more injuries? So if it's not an apparent machete to the neck injury, a lot of times as it turns out as a knife passes through your neck tissues, it tends to push many of them out of the way and can often preserve that.

Dr. Greg Dion:

So sometimes the best thing is to wait. We're really good at managing vocal fold immobility and certain, so if it's obviously cut, you can do a primary reanastomosis. Then people might consider like an anastomosis, but in a lot of those cases, you will have wanted to understand better the nerve function and considered laryngeal EMG or observation evaluation for a little bit before you're diving into the shallow end of the pool.

Dr. Greg Dion:

Then these patients, obviously, what happens to them is dependent in terms of where do they go, the floor, the ward, the ICU. Is dependent upon the intervention that you make. A simple incision and framework repair of a single laryngeal fracture with no airway stuff could potentially be observed with steroids overnight and antireflux meds. And if you've made the decision and then like antibiotics.

Dr. Greg Dion:

But more complex intervention where you've got alternative airway, or it's a keel, or a T Tube or something is going to require additional management in the ICU.

Dr. John Marinelli:

What are complications you want to be mindful of when operating on these patients?

Dr. Greg Dion:

I think complications are the biggest concern and it's what drives our early treatment. So at the end of the day, as much as I'd like to say, the role of the larynx is for me and you to have these wonderful talks on podcasts, but the reality is that so that we can breathe so we can have these talks, obviously. So we got to make sure the airway is fine. So we worry things like airway stenosis, laryngotracheal stenosis, subglottic stenosis, laryngeal stenosis.

Dr. Greg Dion:

All those things are the things that we worry about in doing surgery to prevent, hence the reason that we're putting keels in, and T Tubes, and endoscopic evaluations, and repairing tears. Then we want to preserve the voice, and so we have to think about vocal fold immobility. Vocal fold immobility could be a complication as we talked about from the type of injury or a variety of other issues.

Dr. Greg Dion:

And so the management of that is quite broad that topic's being covered in other multiple podcasts because of its breadth. But it involves medialization procedures, reinnervation procedures depending upon that underlying pathophysiology. And also it has a temporal relationship to the injury because if we think it's edema-related or compressive injury, that that might take months, and months, and months to come back. So, we have to think about that.

Dr. Greg Dion:

Then we really want the patient to sound normal, and so walking around hoarse is problematic for any number of reasons, but that might be from scarring, from an endolaryngeal injury. It could be ultimately vocal fold immobility, maladaptive vocal patterns afterwards, in which you're going to talk about voice therapy. Then with any other healing, you want to talk about granulomas and infections.

Dr. Greg Dion:

Granulomas are common in the airway because they got a lot of different tissue and bugs there that cause irritation. And so getting ahead of a granulation tissue is important. If you come in and those granulomas can be large and actually create airway issues. So those can be treated with inhalation steroids or even in-office KTP lasers as options. Those are some of the more common things to think about in terms of complications would be voice issues, airway stenosis, vocal fold immobility, hopefully, which you didn't cause during any of your repairs.

Dr. Greg Dion:

Granuloma formation, and it goes without saying that anytime we make an incision in the neck, there's an injury, you worry about infection though. Costochondritis itself for primary cartilage infections are thankfully relatively rare based on our current treatment outcomes.

Dr. John Marinelli:

When we think about outcomes, and follow up, and whatnot, I know it'll depend a bit about whether or not the patient had conservative versus surgical management. But how do you like to follow these patients up?

Dr. Greg Dion:

This is great question. I think spinning back to our observation patients. So if it was just a hemorrhage, I think overnight ops, and then a good close followup to make sure it's resolving with some voice rest would be ideal. The nondisplaced fracture that otherwise has no complaints or no mucosal injuries. You're going to do a similar treatment plan for that patient.

Dr. Greg Dion:

And then that patient, particularly if this was a contact sports-induced injury, they need to not be doing contact sports. If this person is like a deep sea diver or something like, they need to be not doing those things, which could potentiate the problem and you're going to see them back in a couple of weeks. Now, if the patient was admitted with sole crepitus and you couldn't find any injury, or laceration, or anything, then you need to make sure that the trajectory of their crepitus is resolving.

Dr. Greg Dion:

They need to be not active and you're, again, going to follow those patients fairly closely after they've been observed for improvement.

Dr. Greg Dion:

If you've done surgery, the reality is like a small, minor repair to like laryngeal framework. Might only require an overnight observation after which they can leave. There are reports of people being able to do just a simple repair of a larynx and send the patient on the same day, but most people would watch them overnight, make sure they're doing fine a day, maybe two and get them set for followup.

Dr. Greg Dion:

But once you've started the surgery, you need to consider, do I need to worry about airway compromise? Are there other issues that I need to think about? A patient who's had a tracheotomy and has maybe a T Tube or a keel, then you got to start deciding, okay, is that patient safe to go home? Does



that patient have the right care plan? Do they and their family know how to manage a T Tube? Are they safe to do that? What's going to be the next step?

Dr. Greg Dion:

Because if you've done an alternative airway, you're not done because you know that you need to go back and get them back to a normal neck, a normal airway and watch those tissues heal. I think really understanding that these patients are going to be with you until you can make sure that they are better is really important. Even if you think it's just edema causing a temporary vocal fold immobility, you need to follow that patient until that either resolves or you need to intervene, and that could take many, many months.

Dr. Greg Dion:

Obviously, you don't want to leave that patient with no intervention, if they're hoarse with a mobility, you can do some form of medialization temporary procedure, but you want to follow their injury as it pertains to what you see in there. I guess that's probably a little more of a roundabout answer than we had hoped for, but the reality is, you're going to follow what you got involved with.

Dr. Greg Dion:

If you did a bunch of endolaryngeal suturing or you put back together the larynx via midline thyroidectomy, you're actually going to want to consider, am I going to need to go back to the operating room to remove my keel, or stent, or T Tube? Am I going to do a second procedure in which I do additional repair or inject some steroids to help reduce any healing issues? So, those considerations need to be discussed both with your operative team and the patient as you kind of approach them.

Dr. Greg Dion:

While it seems really complex and in-depth, I think the beauty of laryngeal trauma is a lot of it just develops on its own and tells you what we're going to need to do. What you want to think about this in summary, hey, I'm seeing a patient. This patient needs something right now. It's the general concept, am I going to be diving head first in? Do I need to do something right now?

Dr. Greg Dion:

Is this patient an acute problem? No. Okay, so they're not an acute problem. Alright. They're not an acute problem, what do I have to do? What are my problems? What do I have to address them? Then as you proceed down that pathway, each one of those is going to tell you how to follow it up, what to worry about next. So that's a really nice thing is, is the natural evolution of treating laryngeal trauma as it helps direct you to your next step.

Dr. Greg Dion:

For me, my ears always perk up a little bit when a resident calls me and say, "Hey, I got a laryngeal trauma for you." So it's something that I like and I think that it is a little bit... It makes a lot of otolaryngologists and residents very apprehensive when they first see because it can be a really concerning. But when you break it down into a simple approach, I think that the otolaryngologist is well trained to handle these and really ensure optimal outcomes for patients.

Dr. John Marinelli:

Awesome, Dr. Dion. Is there anything before I transition to the summary portion of the podcast? Anything else you'd like to add?

Dr. Greg Dion:

No, I think this was a great discussion and I hope that I was able to help some people out in terms of their approach and thinking about laryngeal trauma.

Dr. John Marinelli:

Yeah.

Dr. John Marinelli:

I'll transition to our summary portion now. Laryngeal traumas of rare, but potentially life threatening, form of head and neck trauma. Can occur in a wide variety of settings. Oftentimes it's blunt trauma, but rarely can also be penetrating trauma like gunshot wounds or stabbings for instance. Patients symptomatically will present with dysphonia, sometimes sensation of subcutaneous emphysema, air in the neck, dysphasia, cough, stridor, some shortness of breath, hemoptysis.

Dr. John Marinelli:

Might experience some cervicalgia, neck pain. When you're working up the patient, you're seeing them for the first time, obviously, the primary consideration should be establishing a safe airway, and especially in a patient with neck trauma, having a stable cervical spine, things you want to be mindful of before seeing the patient.

Dr. John Marinelli:

But otherwise, doing a complete history and physical exam is very important. Being mindful of how the patient is able to talk to you. Are they short of breath? Having difficulty to breathe, that sort of thing. Flexible laryngoscopy is a key component of the physical exam. Of course, should be done by an experienced person, just especially in the patient with more significant laryngeal trauma. You don't want to exacerbate an acute airway decline.

Dr. John Marinelli:

A CT imaging of the neck is key in terms of not only evaluating the injury, but also preoperative planning. Then if you're concerned about esophageal injury, you want to start with an esophagram with Gastrografin and opposed to barium just to avoid the barium sulfate-induced mediastinitis.

Dr. John Marinelli:

Talked a little bit about neck zones. Laryngeal trauma is obviously in the second zone of the neck. And in terms of penetrating trauma, that's classically considered the must explore zone of the neck. Then touched on different management conservative versus surgical management. Conservative management often being employed for smaller injuries such as a Schaefer Affirming grade one injury, but the rest of typically involving some sort of intervention.

Dr. John Marinelli:

Then postoperatively, things to be very mindful of is ongoing voice issues and the potential for stenosis of the airways, as well as vocal fold immobility in development of granulation tissue.

Dr. John Marinelli:

I'll transition now to the questions portion of the podcast where I'll ask a question, pause for a couple seconds, allow you to think about the answer, and then I'll give you the correct answer. First question of the episode, how does age factor into the injury patterns commonly observed in laryngeal trauma?

Dr. John Marinelli:

In laryngeal trauma, the younger the patient, the more elastic the cartilage, and therefore laryngeal fractures are very uncommon in kids and more common as patients age, as the cartilage ossifies. Then moreover, it's important to remember that the larynx sits higher in kids, especially very young kids such as toddlers, or preschool age, kindergarten, that sort of thing. So the airway can actually have some protection just by sitting higher in the neck.

Dr. John Marinelli:

Next question, if concerned about a concomitant esophageal injury, what studies should you order? And do you want contrast? Or what kind of contrast do you want to use?

Dr. John Marinelli:

Correct study in this setting is esophagram with Gastrografin. Reason being you want to do that prior to using barium just to avoid the barium sulfate-induced mediastinitis that can occur in the setting of a true esophageal injury.

Dr. John Marinelli:

Third question, how are zones of the neck broken down when thinking about head to neck trauma? The zones of the neck can be broken down in three categories, starting from bottom moving to the top. First zone of the neck is below the cricoid cartilage, lower neck. In this zone, you've got the carotid vertebral and subclavian arteries, the lung trachea, esophagus, thoracic duct, and other structures in that area.

Dr. John Marinelli:

The second zone of the neck is the mid portion. It extends from the cricoid all the way up to the mandible. This is where context of laryngeal trauma, the larynx obviously sits. Also that associated portion of the esophagus as well as nerves recurrent laryngeal nerve and to vagus nerves. And traditionally in the setting of penetrating trauma, this is the zone that requires mandatory exploration, although that has changed a bit over time.

Dr. John Marinelli:

And last zone is the upper neck above the mandible, angular mandible and the contents of the carotid, vestibular arteries, jugular vein, parotid, submandibular glands and cranial nerves.

Dr. John Marinelli:

Last question of the episode, what is the feared postoperative complication of concerned in surgically managed laryngotracheal trauma? Feared complication is supraglottic, glottic or subglottic, or even tracheal stenosis that can be managed by serial dilations, resections, an anastomosis or even reconstruction, depending on the severity.

Dr. John Marinelli:

That will wrap things up for today. Thank you so much for joining us and we'll catch you next time.