

[MUSIC PLAYING]

SPEAKER 1: Like I said, to recap, tetraplegia-- so it's your upper and your lower extremities affected, Sensory, as well as motor impairment. And the impairment is either the complete or the incomplete, which we all just touched on earlier. So the main ones that you think of for a tetra is C4 to C8. So C4 breathing, so C5 is biceps, then you've got C6, wrist extension, and then you have elbow extension, C7, and then your finger flexors, C8-- so 5, 6, 7, 8.

So the incidence and the prevalence for a spinal cord injury for tetras-- so you're more likely to actually have an incomplete versus a complete tetra, which is really interesting, so 45% for an incomplete versus about 14% for a complete tetra. The most common cause for a spinal cord injury death is more likely septicemia or pneumonia. And then also the prevalence for self feeding in dysphagia is really unknown, but it's very high with patients who have tetraplegia, which is interesting.

So the risk factors-- so level of injury, obviously, the severity of the injury; whether or not they have a tracheotomy, different things like that, or a poor cough or breathing support, as well as their age. That's a very important thing as well.

ROBERT MASTERSON: For this patient population, it's not as well understood, perhaps, with the presence and the etiology, or just the physical characteristics of swallowing problems in this group. But there are some commonalities. And we should just simply, if we have a few minutes, just simply review basic swallow physiology.

And as you probably know, swallowing function has cortical, as well as sort of brain stem-mediated inputs. But there is also some upper spinal cord input from T1 to T2 that does innervate some of the muscles of swallowing. And a lot of attention is obviously given to patients with stroke, but there's not as much attention for spinal cord.

But in terms of normal swallow physiology, most patients are well aware that its brain stem mediated. There's an area of the brain that's called the central pattern generator. And this integrates motor, as well as sensory, input to do something dynamically.

And the reason I have a picture there of the city of Pittsburgh there-- the point is that, geographically, if you looked at the trachea and the esophagus and the oral pharynx, it's really very similar to that sort of geography. You have the Mon and the Allegheny and the Ohio, right? And if you think of the oral pharynx as the Ohio, and you thought of the trachea as maybe the Allegheny, and maybe you might think of the esophagus as the Mon. Of course, the flow of the rivers is not quite right for this idea.

But the idea is still appropriate-- that when people are eating and swallowing, food or liquids can get misdirected into the airway. Right? So maybe that's not somewhat unlike a misdirection of a boat going down the wrong way. But swallowing is a complicated activity, more complicated than we first thought.

A long time ago, 20, 30 years ago, perhaps people thought this was just a reflexive act. And there are acts in swallowing that are somewhat automatic. For example swallowing your saliva. There is some automaticity or nonvolitional act that you're doing. You're not having to concentrate to swallow your saliva.

Your brain stem, it's immediate activity. You'll do that about 1,000 to 1,500 times today without really putting a lot of thought. However, when you go to drink hot coffee, you will definitely concentrate. Because you don't want to burn your mouth unless you really know what you're doing.

You bring your lips together. You have a good feel. You control the liquid. And if you don't control the liquid, it could be misdirected. So that's something that you have a lot of coordination.

And finally, the last aspect is really coordinating breathing and swallowing. And with patients with high spinal cord injuries, that's really a challenge with breathing. Because it's already known that they're breathing at lung volumes which are much lower because of, sometimes, the impairment of the diaphragm.

And that's a big factor. Especially early on in their injury phase, they may require intubation or tracheostomy. So it's really critical that the medical team and the therapist understand the relationship between normal swallowing and breathing.

And you probably, I hope, know this that if you're walking very quickly or maybe even running, and you go to drink water, you have to hold your breath. So if you don't coordinate breathing and swallowing, you're going to have a problem. So that's something important to think about with our spinal cord population. Imagine what it must feel like to have those lower lung volumes, the immobility, and to have a weaker cough. So we always try to think about that when we're looking at the bigger system.

Traditionally, people who have evaluated swallowing have tried to conceptualize swallowing in phases. But really, in a lot of young people, it happens just very quickly. All of the phases overlap.

But swallowing phases are thought to be first, oral prep, like preparing foods or liquids to be sort of a volume or amount that can be controlled and sent to the posterior oral cavity. And that's called the oral transit stage. And then finally, once it's in the back of the tongue and up against the soft palate, you're ready to initiate by pharyngeal swallowing. They call that the stage transition. It's moving from the oral phase to the pharyngeal phase.

And then in the pharyngeal phase, we have a series of overlapping physiologic events that people have been studying for some time. Then finally, the last phase is the esophageal phase. And even that's sort of sometimes broken down between the differentiation between smooth muscle and striated muscle.

Believe it or not, there is some thinking now that people do have some control of the upper esophagus. Hence, people being able to swallow swords. So there may be more input than we once thought. [INAUDIBLE] thought once it's in, your esophagus takes over. You know, spinal cord and brain stem-mediated responses kind of take over those effects. But there is some evidence that people can exert some control there.

How would we define dysphagia? Well, dysphagia, just generally speaking, is just difficulty eating and swallowing, which might include one of the following tasks-- chewing food, swallowing solids or liquids, and the presence of coughing or choking when eating, or even food sticking in the throat and chest. And it's estimated about 15 million people in the US suffer from dysphagia. This includes esophageal dysphagia.

So it's quite common. And usually, when you meet people that complain of some trouble swallowing, the most common complaint is actually esophageal dysphagia, followed by pharyngeal oral dysphagia.

So we do get a lot of referrals for people who say, oh, I swallow a pill. And you know, I can't get my potassium down. It's really big. And it sticks right here at the sternal notch. And that's a good referral for a speech pathologist, but it's most likely that would be esophageal dysphagia.

Does anyone ever feel like they have trouble swallowing? Can be-- I'll just say that I do sometimes. Sometimes if I have a little bit of heartburn or exacerbation of heartburn or even reflux, I can notice that there's more-- I might have a little more trouble with solids, which is pretty common in esophageal dysphagia.

And something that's important to note on this slide-- this comes from Dr. Kim Coyle, who is a researcher and speech pathologist at the University of Pittsburgh Medical Center over at Presby, has really kind of coined this phrase. And this is just a slide that he's coined to talk about the fact that really looking at the etiology of dysphagia, that it's not specifically a disease. It's a symptom of something else. So that patients who suffer a spinal cord injury or acute tetraplegia, that itself does create disability.

And one of the consequences might be that they have dysphagia, but it's those underlying conditions like impairment of nerve function, or perhaps edema, or difficulty with trunk control, or movements that are producing the dysphagia itself. And then, secondarily to that, the consequences of dysphagia could be weight loss, pulmonary congestion, pneumonia, aspiration, choking, and in some cases, additional quality of life issues, as well. So those are things to think about with dysphagia.

And then, how do people traditionally manage dysphagia? This is just an example of some of the treatments that have been studied over the last 20 to 30 years. As a speech pathologist myself, usually the first approach that a lot of therapists do, just in the acute care model, is to modify diets and viscosities, which is obviously not ideal.

Because a lot of people don't want their food really messed with, right? You don't want to see somebody on pureed food or thickened liquids. A more ideal concept is for patients to use strategies, or compensation, or perhaps strengthening exercises to improve swallow function without limiting quality of life.

There are a few other approaches that might sound familiar to you. One is a approach, which is sort of Bobath and neurodevelopmental, which is integrating systems, looking at how people move their bodies in time and space, or how they learn those movements in both motor and sensory arenas to improve swallowing function, and that's actually true. Sometimes you will start, if you work with occupational therapy and physical therapy, you really do see gains as a teammate when patients can adjust their positioning, or they have more strength, or they have more energy. So you might see some of those translate to swallowing. So that really requires teamwork, knowing what your co-worker is working on in therapy.

And finally, sort of towards the bottom, there have been some improvements with patients who use biofeedback, looking at muscle movements and exercises and seeing how people move their bodies, as well as a few other medical and surgical interventions. And one of the cases that we'll talk about at the end here-- if there's time, I hope-- is to talk about a person who went through a lot of surgical interventions to improve swallowing. Any questions so far about this stuff? OK.

And finally, just to kind of highlight this, I think we all, as health care professionals, know how important it is to be or to have team members. And this is a pretty big list-- I hope not too big-- but really emphasizing how many specialists I think it really does take to maximize feeding and swallowing issues. And it's not just the responsibility of the speech pathologist to prevent or reduce complications from dysphagia.

It's really a team approach. Because the speech pathologist might not be here at 6 o'clock tonight on one of the acute care floors. We're really depending a lot on the aides, the nurses, as well as even the kitchen and the dietary department to ensure safety.

So I think that also emphasizes how important it is to communicate and really to cross train, right? The speech pathologist should be working with the occupational therapist to understand how the impact of self feeding would be affecting swallowing function. So I think it's time to talk about self feeding. Sorry. You got it?

SPEAKER 1:

Yeah. A lot of swapping back and forth. So self feeding-- so this is a very important goal for my patients. This is actually personally one of my first goals that I always go into for my patients. So any of my patients that come in with tetraplegia, central cord-- they could actually work through it, which we'll get into a little bit more later on.

But like I said, this is my very first goal for the patient, not necessarily, like, ooh, let's get dressed. Let's brush our teeth. Let's eat. Because it just improves their quality of life just a little bit more.

And then we also went over the muscle groups ahead of time. So I'm just going to kind of go into a little bit more of different adaptive equipment and devices that we would use specifically. So I'm sure you guys are all familiar with the dorsal wrist splint. Is anybody not familiar with that? No? Oh, awesome. Yay.

So this is more so for positioning. It helps with that wrist drop. And a lot of times people don't realize you want to put your hand in a more neutral position, which is great and all.

But sometimes, actually having that wrist drop will increase the patient's ability to be able to stab at their food. It's not necessarily always helpful for them to have it in this position. So I like to call it the little floppy wrist. It's easier for them to be able to stab or scoop at that item, which is pretty cool.

So other different assistive devices-- we have the built up foam, as well as the premade utensils. I know for us, personally, it's really difficult to get those premade built up utensils from our kitchen. And we only have so many within the department.

So the red foam is the easiest. You can kind of tell that there's three different types of foam-- red, blue, and brown. And they have different size holes. So the red is actually the easiest for individuals for eating utensils.

Now I don't know if your site has plastic utensils, but we do, which is probably the worst possible thing. Unless you have a really awesome heat gun that you're not afraid that you're going to burn your face or your hair off with, which-- I'm terrified. I always get metal utensils to be able to bend those forks or those spoons around. So in that way, it's easier for them to be able to stab, because you might not have that pronation, supination ability.

And then also different types of scoop bowls and scoop dishes, obviously, like OT 101, Rehab 101. But then just different types of cups and mugs, so a lot of our tetras might not be able to-- they can't grasp. But they might not be able to bend forward to be able to reach something. So being able to adapt a straw so they're able to reach that device, different kinds of things.

And I know that there is a huge straw ban epidemic, which we can kind of get into a little bit more. We have a local celebrity here about the straw epidemic. But it's definitely a necessity for our individuals, especially with the acute tetras, so just to touch on that.

Now there is different assistive devices out there. I'm sure everyone's heard of the mobile arm support or at least some type of variation? So this first picture we have-- it actually clamps onto a table top. You can move it from place to place, which is pretty cool. Then we have this huge, bulky, mobile arm support that I don't know how many people actually use nowadays. But then we also have another one off to the side, which I have the third picture here for us to look at.

But a lot of times using these different devices can actually be more cumbersome. And it can be really frustrating for not only the patient, but the therapist, as well. So you've got to remember, the patient's hungry. They want to eat. They don't want to just sit there and feel, like, all right. Oh, my gosh. This is taking forever.

I don't really care. I just want to eat my breakfast. I want to eat my lunch. I have to make a phone call in a little bit. So a lot of times just being able to do hand over hand assist-- so then that way you know what would be working best for that patient.

And also how many of your tetras are going to be sitting in a chair like that? Let's be realistic. They're probably going to be in a high back power wheelchair of some sort. So maybe using another piece of equipment might be more cumbersome. Not going to say it's not helpful sometimes, but it kind of just weighs the pros and cons. And it depends on the patient's specific.

Now proper setup of an individual-- so we have this young lady here. She has the mobile arm support on her right extremity. She has a dorsal wrist splint and a U cuff with the bent utensil, a scoop dish. So things for this-- you want to make sure that the body positioning, that they're sitting upright. Even if they're in bed, it's really important to make sure somebody is sitting upright obviously.

I can't tell you how many times Rob has a little heart attack that somebody is eating in bed, like, choking, dysphagia, risk. Plus sitting up and eating is more of a natural position. I don't really eat many foods laying down in bed.

But then, also, a lot of times my patients come to me with elbow flexion, but they have decreased shoulder strength. So assessing that range of motion and then strength, as well, is really important to know what intervention should I provide. Is using that piece of equipment good at this time, or should I just provide assist at the elbow or the wrist for them to be able to do these simple movements and just kind of get those movements, like-- feeling what they're doing again.

And then also, you don't always have to work on eating in the clinic. Like I said, sometimes the patient's just hungry. They want to eat their meals. You can do other types of things.

So what I like to do is just like working on coordination, strength, and movement. But not just, like, ooh, let me lift a dumbbell. No-- you can have them working on using that fork, that spoon, using that U cuff, but then working on using that dorsal wrist splint. But also working on them being able to scoop up those little tiny pegs that we all love, blocks, even sand, or those noodles that we have our patients use for desensitization.

And then another thing is an issue that a lot of my patients have had is they might be able to stab at their food, but they really can't get into that pineapple or the cantaloupe, whatever. It's a thicker thing. So using different resistive putties, which is pretty interesting-- I've rolled up little putty balls.

And obviously, you can't let them sit on the table too long. But having them stab at that and then have somewhere to place it after the fact, so it's working on not only the coordination of the movement, but the strength of being able to stab through that object, which is pretty helpful. And then these are all working on that specific movements for that patient, which is pretty cool.

You also want to really consider different braces. So at this time, she had a cervical brace. So luckily, she was able to bend forward at the trunk to be able to look down her food. But a lot of times, we have patients in TLSOs, CTO braces.

So you might have to come up with a different way for them to adapt, maybe have the table a little higher. Having a white bowl so then that way they can see the different foods instead of it being black, just to be able to see the contrast because they might have low vision. Going on to comorbidities-- if they had decreased shoulder range of motion prior, so all the little things that you should really kind of think about and work on. Questions yet? Quiet, you guys are just, like, (WHISPERING) it's the end of the day. I'm so excited.

So the research shows-- for the most part, it's just the perceived quality of life could have a negative effect on the secondary complications. So whether you're working with this patient in acute or whether they're doing a long term care facility, basically you want to strive for a better quality of life. And I feel like that's with any of our disciplines, just striving for increasing the quality of life for those patients.

ROBERT

MASTERSON:

I'm going to try to go over some cases. And I think the advantage is we actually have a physician here who might remember the case and can add a little detail. But what I want to talk about are two cases with some imaging.

In speech pathology, when we evaluate swallowing function, we try to use imaging or exams to tell us more information about how they physiologically swallow. However, those exams themselves are only a few minutes in time. We have to look at a variety of situations in terms of how are they doing from a medical standpoint-- in terms of how they're breathing, and whether or not they would have infection, how are they performing during their ADLs and during physical therapy, and how strong are they, and whether or not they have other complications.

The person who I'm going to talk about first is an older gentleman who suffered a fall. And after his fall, he suffered a right frontal bleed, an intraventricular hemorrhage, as well as a cervical spine injury. It required surgery.

He was admitted on the 2nd of November. And then the next day, he required a 4-6 ACDF and corpectomy. Sometimes when these patients undergo cervical spine injuries, it's well documented that there will be the development or incidents of pharyngeal dysphagia.

For years, there was some debate about this under the ortho and neurosurgical literature. That has since been well-established in speech pathology that this group has dysphagia. There are varying degrees of estimates. But in my opinion, in clinical practice, it's nearly 95% of the patients, at least post op, will have some form of dysphagia.

They can compensate for that in terms of modifying their diet or how they might swallow. But if you would just peripherally ask people on the street, and say, hey, I noticed you had neck surgery. What was that like? What were the first couple of days like swallowing?

Like, oh, initially, it was a little difficult to swallow. But eventually, I did resume a regular diet. Some patients after this surgery, say, boy, I still choke sometimes. And I still feel like it's different how I swallow.

So that surgery itself, because of the changes in anatomy and some of the necessary movement of nerves and muscles, can create this posterior pharyngeal wall edema. And I'm going to show you a case that went to our rehab unit. And he was only there for a brief period of time. But his dysphagia was quite a barrier to his quality of life and his ability to gain weight and to perform in therapy. So that's why a speech pathologist is there and they're part of that rehab team is really to get that person moving forward.

So this particular person had a swallow study, an MBS, which I'm going to show you. And it's not going to take you very long to see what the problem is. Because as soon as I turn the [INAUDIBLE] on, you're going to see, like, oh, my goodness, you know?

There's a lot of edema. So initially, they came to the rehab unit with a feeding tube, which was quite uncomfortable for the patient and self-limiting. And did undergo a short course of Decadron, which brought the swelling down.

So I hope-- this is an example. This is actually a different case that shows in the literature that significant amount of edema. And you can see that yellow line there. And that's what we're talking about. We're talking about soft tissue changes which push the pharynx forward and in some cases, can abut the epiglottis.

And I don't have a laser pointer to show you this. But it's essentially this area. That's the epiglottis. And you can see this distance.

And that distance has been studied in the literature. And recently there has been some evidence to suggest that the physical distance or amount of edema is predictive of whether or not the patient would develop pharyngeal dysphagia. And additionally, this would also put a patient at risk for unilateral or bilateral vocal fold injury or paralysis, which would create some changes in voice.

But it could also impair airway protection. And the major function of the vocal folds is protecting your airway when you swallow. Voicing is important. But in terms of aspiration, that's its major function, along with epiglottic inversion.

And in this population, what's typically impaired, initially, on these small studies is some of the superior motion of what's called higher laryngeal elevation. And that's movement of that hyoid bone, which looks like a little L. If you see that little yellow line, it's just anterior to that. And the job of that bone is to move forward and superiorly to create that movement of the epiglottis to invert.

And when you do these kinds of swallow studies in this typical population, you almost always see some form of residue. And in some cases, you'll see some penetration, as well as aspiration. And aspiration just simply means material entering below the level of the vocal fold, or what we call the glottic plane.

But aspiration typically happens after the swallow [INAUDIBLE]. So it's really important that the speech pathologist differentiates between aspiration associated with medical conditions like stroke or Parkinson's versus aspiration that results from weakness or residue patterns. And I'm going to show you some exams where that was the case.

All right. So you can quickly see the hardware, right? You could see it there at that ACDF. And you can see how the pharyngeal wall is pushed forward. And you can also see-- here is the epiglottis. And it looks like there's almost [INAUDIBLE].

And I want to try to play this-- I hope-- oh, there it is. And you're going to see this is thin barium with this patient. You'll see barium enter into the vallecula. And you can see aspiration as a result of that residue.

And this person has so much edema that, unfortunately, they're barely passing barium through the upper esophagus right here. Right? And you can just see that that's essentially a barrier to normal swallow function. Right? And when speech pathologists look at swallow function under video fluoroscopy, they're looking at several areas.

They're looking how the basic tongue is contacting the pharyngeal wall. They're looking at how the hyoid and the larynx are elevating, getting out of the way for the path of the bolus. And obviously, they're looking for whether or not the person's aspirating.

In this particular case, early on, in post op day four, this person had a suction wand at the bed. And you knew the guy had trouble swallowing. This unfortunately necessitated a feeding tube.

This is after Decadron. And you can see a pretty dramatic difference between-- at the surgical site, you can see a real difference in the posterior pharyngeal wall. I hope everyone can kind of see that, right? Here you can see, from the original side, you can see that there's a little bit more movement.

However, this person still was at risk and did require compensatory swallow strategies. And the swallow strategies that this person needed was an effortful swallow with a cough, and then a reswallow. I'll just show you that. But you can see better passage of the barium.

You can still see a little bit of aspiration there with these thin liquids. And obviously, this person did not immediately resume regular foods and regular textures, but was started on full liquids to start, with some strategies. You can see there's some better, some improved movement.

And this has also been documented in the literature. The patients who undergo this type of surgery, that have posterior pharyngeal wall edema, do respond to steroids to improve swallow function. But you still need a speech pathologist to kind of work with those patients, as well as occupational therapy. Because again, if this person is in the dining room, and they're suffering from some upper extremity weakness and requiring feeding, usually they're going to be taking thin liquids from a straw.

So the speech pathologist has to kind of be aware of that because the volume of a liquid, when you draw from a straw, there's a little bit more pressure within the oral cavity and the pharyngeal cavity. So something like paralysis of the vocal folds or any physiologic change where a patient's taking a thin liquid, you really have to be careful with that. That's not to say that we restrict straws, but we are aware of that because in some cases, patients are not given the opportunity to take straws with liquids.

In spinal cord, that could be a particular conundrum, right? And that's not specifically an environmental issue for landfills and things like this. It's just a safety issue. Any questions about that, about this specific case?

Once this person got Decadron, he did progress, I think, fairly well with swallowing. And one of the problems, I think, with steroids that a lot of neurosurgeons are a little reticent to initiate in this surgery is that it would impair normal wound healing. So they would obviously be real cautious about the use of steroids.

And there's a lot of other complications potentially with steroids, as well. But in this particular case, when the surgery was lengthy and required a lot of cutting and moving of tissue, unfortunately, there is edema. So it's something that we have to kind of manage sometimes. OK.

This second case that I'm going to go over with you is a little bit more protracted and prolonged. And this guy was a young man who was riding-- if I remember correctly-- he was riding an ATV at, I believe, a church picnic and had been drinking, unfortunately, and crashed an ATV, and then suffered pretty significant trauma. Initially, when he came from this outside hospital in late July, he had already undergone-- or I should say early August here-- he had already undergone a C3 to C6 ACDF.

And there were some complications with that just like the case I just showed you, there were some complications with that surgery, including a right vocal paralysis and some dysphagia. It was also noted in this particular case that this patient had this prevertebral edema. So that impacted pharyngeal swallow function.

He did undergo steroid treatment. But the steroid treatment is quite short. And again, I think the reason being is that running steroids in these particular patients would impair wound healing. So they only ran steroids for a very short amount of time.

Initially, we believed that this patient would tolerate a regular diet-- which is pretty intense for this type of surgery and the complications he had-- and nectar thick liquids. When he was admitted with us, he was noted to be an Asia C, according to the spinal cord assessment rating. When I first saw the patient at bedside, he wasn't really tolerating the diet. He was demonstrating a lot more signs and symptoms of pharyngeal dysphagia, and so it made me a little suspicious.

So we ordered a repeat modified barium swallow study. And then initially, I believe, he was a tetraplegic, as well. At that point, he was issued a power wheelchair, at least fitted for one.

But he was dependent for his feeding. So that's one of those situations where he was particularly at risk because he was hungry. You know, he's waiting on staff members to feed him. So he was sometimes quite grumpy with us, I think-- but the fact that he was on thickened liquids or a modified diet.

Another thing, too, on that initial admission-- he really complained to us a lot of pain. And sometimes it's really hard to judge where the pain is coming from. But he particularly said-- and if this ever happens, I hope this will explain the case later-- but he kind of localized the pain to his throat. He said when he swallowed, he would kind of give you some facial grimacing.

And so that made me concerned, as well. Because he had had this surgery, and one of the unfortunate complications from that surgery can be fistulas or hardware displacement. And that's known in the literature. So if a patient presents to you in that way, and they localize this to the upper throat or neck, or they've increased secretions, that's something that you'll want to really be careful about.

So when I did his first modify, I did two-- one on the third and one on the 10th-- and I'll show you both. There was aspiration due to incomplete closure. There was a lot of residue patterns.

And the regular diet and [INAUDIBLE] diet that I originally thought might work, we had to kind of downgrade that. So I changed the diet to really just a liquid diet. And we maintained the nectar thick liquid.

I also encouraged him to use what's called an effortful swallowing. Does everybody know what an effortful swallow-- it's kind of what it sounds like. So if you swallow really hard right now, just get some saliva, if you have some saliva in your mouth right now-- you almost kind of, like, bear down, and try to use the base of your tongue, your soft palate, and your pharynx to squeeze, like you're squeezing something.

And there is some evidence that says when people do that, they get a little more increase in pressure, generating intraoral pressure to drive a bolus into the pharynx and into the esophagus. And that's really the goal. If these patients have residue patterns, and they have weak swallows, they accumulate saliva, secretions, mucus, and the longer that stuff's in the throat, the higher the risk for developing complications, including pneumonia. So that's a really important thing. In this particular case, that's what we recommended is that he swallow really hard. And then after he swallowed hard, we asked him to volitionally cough or throat clear after the swallow.

I did two of them. And the second one wasn't terribly different. Although he tended to do a little bit better with residue pattern. So we kind of upped his swallow.

These next two swallows were done and associated with a changing swallowing issue. Because we found an esophageal perforation, unfortunately, on the modified. It was under the modified that we saw barium-- and I'll show you on the imaging-- we saw barium kind of underneath the pharyngeal wall, communicating into sort of a false passage.

We had neurosurgery look at it, an ENT, and they finally realized that this person had a fistula, which was resulting in all this pain. And it was significantly impacting his safety. So after all of these procedures, he was made NPO. And at the very end, before this patient left, all the way in sort of mid-October, he finally got some improvement and was able to resume that other diet, the full liquid diet, using the effortful swallow.

So any questions about that? I'm going to show you the videos right now, I hope. This is just your kind of review. The other specialists, and we've said that it's a multidisciplinary team. And really, it involved everyone.

Otolaryngology was involved in this case from the outside because of the paralysis. We had neurosurgery looking at neck CT film. Obviously, PM&R was coordinating all of these tasks.

We had a radiology double checking whether or not there was, in fact, air or a fistula. And so we had multiple people looking at these images to work as a team. And it really does, I think, require that, especially when there's a complication.

And I put the arrow sign up. And that's what we saw. When we did the modified barium swallow study, you could see the presence of barium in what looked to be the esophagus. And they also noted, I think, a little bit of air.

Sometimes when you see the repeat imaging, neurosurgery will suspect that under film. And then in some cases, they will go to a [INAUDIBLE]. Unfortunately, when you use [INAUDIBLE], this contrast medium in patients that aspirate, that can be quite dangerous.

Because those patients, when they aspirate, it's not barium at that point. It's now almost like a chemical. And when that's aspirated into the lungs, it really creates acute hypoxia, and it can be quite dangerous. And we've had a few of these cases with aspiration. And they immediately are coughing and become really, really short of breath.

In this particular case, unfortunately, in this patient, he did aspirate. And the radiology staff really almost panicked, because this guy became really short of breath. But as I said, they did find a very small fistula.

And I'm not sure exactly why this patient developed the fistula. It could be the use of steroids. I don't know why the patient developed that complication. Sometimes, there may be thinning of the esophagus due to alcohol.

And I believe this patient, unfortunately, did have a pretty significant alcohol history. So you wonder if some of those things may have contributed to that. So luckily, it's an infrequent occurrence.

So this is the first modified that I did. And you can see that the hardware there is from C3 to C7, I believe. And you can see the presence of that feeding tube. Let me see if I can play that there. OK.

And we always start off, I should say, with thin barium. And you can see some aspiration that looks like it's happening due to incomplete glottic closure and perhaps also due to some impaired retroflexion. Did everyone see that? I'll play that again if that's not clear. Put my cursor as to where the aspiration is, put the little finger there, right?

And you can see it come through the anterior commissure and into along the tracheal wall. And in those cases when you're working with patients, you're always hoping that they're going to give you a cough, right? If you're giving a little bit of thin barium or liquid, you're always wanting them to cough or at least feel the aspiration of that so that you can work with them therapeutically and say, oh, look.

We don't want this to happen on a frequent basis. Because A, you're dependent on your feeding, right? You're in a power wheelchair. And you might be using a straw. And if you're getting those aspiration events, you want the patient to be able to anticipate and recover for it.

And this is also another exam here. And this is a patient who did respond well to compensatory strategy. Because he was cognitively intact, and he was able to follow through with those strategies. And he didn't want to aspirate, either, obviously. He was well aware of aspiration, so he was looking to prevent it.

And this is a repeat, about a week ago. We often use these as, sometimes, measures to measure physiologic change. And you can see I'm asking him, on this exam, to cough or breathe out.

I don't know if you could see that on that exam, but I'm giving him some nectar thick barium here. I'm saying cough, cough, and swallow. So you can see, in that case, he didn't aspirate.

And it's always good to check your swallow strategies here. As a speech pathologist, you want to base how you're treating a patient on science, right? It may be only three minutes, but if you have at least a sense of what the swallow physiology is, that's information that can be very helpful in managing complications.

And on this exam, I'm going to try to show you-- I left the cursor there on this image to show you where to look for the fistula. And often, when you're doing swallow studies, if you do enough of them, you start seeing-- see it there? You'll start to develop a better vision. And it's because the light is a little down here.

But if you look again at where that arrow is, you can see a small line going diagonally toward that arrow. And I'll play that again. Does everyone see that, where that arrow is? See that barium?

OK. That's barium that's going into the prevertebral wall. It's going into the pharynx. It's going into the tissue. And it's not supposed to be there.

And again, the patient complained of mucus and pain. And when you pair that swallow study with the next CT and ENT, that's when they discovered a fistula. And unfortunately, that was a complication for this patient. And that's another image set there. OK.

OK, this is after the repair. So what you can see in this exam is that they took out the anterior hardware and put posterior hardware. And you can see staples there. And this is another gastro view. I believe there's a little bit of aspiration on this one, as well.

Of course, they gave him a pretty sizable amount here. You can see there's a lot more pharyngeal-- posterior pharyngeal wall edema. And there's some aspiration after this wall.

So this patient was obviously very frustrated about just his overall care plan. I think we all struggled as care providers to give him the best option. And he would often be upset with me, I think, because, well, I'm kind of the source of the swallow problem. Sometimes the patients will associate you with thickened liquids, or their pureed diet, or any complication.

That's the job. Your job is to try to protect the patient from harm, but also to improve their quality of life. And he had some other issues with adjustment. He was suffering from what we believe was some post-traumatic stress from his time in the military.

So we all really just wanted to help him, but there were a lot of adjustment-- like psychological issues, social adjustment issues. There were real challenges in his care. People would say, like, oh, he was sweet as pie to me.

And I was, like, well, you know he wasn't always nice to me. but I didn't mind that. I just was focused on helping the team improve his overall outcome. This is one of his last one-- and maybe we should go back to this. You'll see that there is some improvement with some swallowing function there.

He starts getting a bit more barium through the upper esophagus. And that was a real challenge for this patient. Because he now is going on almost three months of his hospital stay. And he's getting very, very frustrated.

And he's also a very thin guy. So we really we're trying to transition this guy from tube feeding to swallowing. And you can see his anatomy is a little different because now this is posterior hardware.

OK. And this-- sorry that this image-- this is his last image. And you can see there's a lot of artifact, we'll say, in this image. And sometimes that happens in these images where you're almost like looking through a little storm here. That's what happens when we record this mod.

And you can see that there's still some residue. There's still impairment of the epiglottis. And there's still aspiration risk. But with strategies, this patient was able, as I said, to resume a modified diet. You guys have any questions about swallowing in this particular case, or just in general, about tetraplegia?