DR. GREG GINSBERG: Hello, my name is Greg Ginsberg, and I'm professor of medicine at the University of Pennsylvania Perelman School of Medicine. I'm a proud member of Penn GI, and I'm the director of endoscopic services at Penn Medicine and with the Abramson Cancer Center.

Today I'm going to be talking to you about the POEM procedure, or per-oral endoscopic myotomy. This is a very exciting, new minimally invasive therapy that marries the best of endoscopic advanced techniques and minimally invasive operative interventions to treat a very challenging medical condition. And it is an example of collaboration across various disciplines to achieve the desired goal of improving patient outcomes and improving patient value and quality.

And I'm going to talk to you today about how we're using this procedure as an emerging therapy for patients with achalasia. The goal of this presentation is for you to the presentation and diagnosis of achalasia, to know the endoscopic and operative management options for patients with achalasia, and to be familiar with per-oral endoscopic myotomy, or POEM, for the treatment of achalasia.

Achalasia is a rare, idiopathic disease of esophageal dymotility. It's relatively uncommon, but we see a large number of patients referred to Penn because we've long been a center of expertise for esophageal disorders. The condition consists of aperistalsis of the esophageal body. That means that the esophagus fails to have normal function to propel food from the mouth into the stomach. And these patients have a hypertensive, lower esophageal sphincter.

This means that the muscular ring at the bottom part of the esophagus that's intended to relax to allow food to go through, and to be contracted to prevent reflux of gastric contents more proximally is at a heightened level of contraction in its resting state, and it fails to relax during the swallowing process. This results in dysphagia or difficulty with swallowing, retention of food contents in the esophagus. These patients experience chest pain when eating, regurgitation of previous ingested contents, and progressive dilation of the esophagus.

There are a variety of treatment options for patients with achalasia that have been

around for a short time, and some of them have been around for a very long time. The medical treatments options for achalasia include pharmacotherapy. And this is the use of orally administered nitrates or calcium channel blockers in an effort to relax muscle contractions. At best, patients may get a 20% partial response. This is largely considered ineffective therapy.

There has been considerable success in the use of botulinum toxin A or Botox that can be injected through the endoscope into the lower esophageal sphincter to allow it to relax. It doesn't do anything to address the more proximal esophagus. And then there are mechanical approaches, including endoscopic pneumatic dilation that we'll demonstrate, and esophagomyotomy.

This is an operative approach, most commonly in the form of the Heller myotomy that's done laparoscopic. And we'll introduce you to the POEM procedure, which achieves the same end as the Heller except through an endoscopic approach. And lastly is excisional therapy. And this is operative for surgical removal of the entire esophagus itself, and that's limited to patients who have very end-stage disease.

The important thing is that there is no cure for achalasia. All of these are treatments to reduce the simultaneous contractions, and to permit relaxation of the lower esophageal sphincter so that patients can have marked improvement in their swallowing function and avoidance of adverse events and complications going down the line.

There's an ongoing European achalasia trial that has released two years results, comparing the Heller myotomy-- this is the operative approach versus pneumatic dilation. And you can see that they compare similarly in terms of successful treatment, with a reduction in the Eckardt score. The Eckardt score is a objective system by which we can assess improvement in symptoms related to achalasia. I'll refer to this throughout the rest of the presentation. And it includes aspects of dysphagia, regurgitation, retro-sternal chest pain and the impact on weight.

So you can see that they compare similarly in terms of efficacy, physiologically as well, timed barium swallow. But the patients who've undergone Heller myotomy have much more reflux episodes, and of course, mucosal tears, which is essentially a perforation that occurred in 12% of this operative group. And that can offer

require prolonged hospitalization or need for operative revision.

And this leads us then to a discussion of per-oral endoscopic myotomy. And just to give you a brief history on how this technology has developed and evolved, in 2004 Chris Gostout and colleagues described a technique for a submucosal flap dissection technique as a safe means to achieve transmural transit into spaces outside the digestive tract. This is a concept that helped to introduce the field of NOTES, which stands for natural orifice transluminal endoscopic surgery. So a very exciting field, and the POEM certainly is one of the best examples of its success.

In 2007, Jay Pashricha and colleagues applied this submucosal tunnel technique to perform a myotomy in the lower esophageal sphincter in four animal subjects. Just a short year later, professor Haru Inoue at the Showa University in Yokohama, who was a surgical endoscopist credited with developing a variety of advanced techniques in endoscopic resection. That is mucosal resection and submucosal dissection in the esophagus in Japan. He presented for clinical cases, human cases, of using this technique, the tunnel technique in the esophagus, to perform a submuscosal myotomy for patients with achalasia. He coined the acronym POEM for per-oral endoscopic submucosal myotomy.

The POEM procedure is broken up into four main portions of the procedure. There's the submucosal entry. And so this is using an endoscope by mouth to create a space into this submucosal field. The next portion is then to create a tunnel into this submucosal space. So we have just a small entry here into the mucosa. The rest is tunnelling down. And then, to create a myotomy, where we use a specially designed endoscopic surgical tools to make a very precise and detailed incision into that circular muscle layer. And finally then to close the entry site, so that we seal this space, protecting it from ingested contents, gastric juices, infection, and the like.

So we begin the exam by doing an inspection of the esophagus. You can see in the video clip to the left. This patient has a dilated esophagus, and has a very tight lower esophageal sphincter here. The endoscope has to almost pop to get through. And you can see a very tight ring here at the lower esophageal sphincter that's almost hugging the endoscope as we come through.

Once we've inspected the esophagus, insured that any retained contents have been

removed, we do very careful measurements, noting the precise location of the lower esophageal sphincter, coinciding with the esophagogastric junction. And we generally withdraw approximately 12 centimeters to begin our mucosal entry. In order to facilitate repeated insertions and withdrawal of the endoscope and tools, we generally place an esophageal over-tube.

That was the strided structure that you saw. We also use this transparent beveled cap, and this enables us to function with the operating devices avoiding any undesired injury to the mucosal surface. So over-tube and beveled cap. The sub-mucosal injection is begun, as I said, approximately 12 centimeters above the lower esophageal sphincter.

We use a standard injection needle. And we're using a methylene blue tinted normal saline solution. We'll inject the full 10 milliliters of solution into the submucosal space. You can appreciate it creates a very large bleb of tissue here, separating the mucosa from the muscle layer. And once that bleb has being created, we'll go ahead and advance a device called a triangle tip knife, or TT knife.

We use then an electro-surgical generator that has a microprocessor that allows us to use some very specific electro-surgical energies. And for this we use something called an endo-cut mode. We are able to puncture the mucosa into that submucosal space that's now filled with the saline solution.

And using endo-cut mode, we will just advance the knife down and create a two centimeter incision into the mucosa. So entry into the submucosal space can be, certainly one of the first challenges that the POEM procedure brings forward. Right now, I'm carefully inspecting some large vessels. And we'll go ahead and use what's called spray coagulation to prevent uncontrolled bleeding there.

Once the submucosal entry has been created, we'll again use this spray coagulation to begin to lyse the submucosal fibers as you see here. This is a non-contact form of electro-surgical energy. And it essentially vaporizes the submucosal fibers. And you can appreciate how this bevel cap now is being used to gently squeeze into that space.

You may be able to appreciate, in the background here, these pinkish white circular muscle fibers. And that represents the muscularis propria layer. And by using just

careful applications of spray coagulation with the TT knife, we're able to enter into this space. So again, a very systematic and controlled process.

Once we've entered into the submucosal space, we'll begin to extend our submucosal tunnel. And we do this by first using an injection catheter with a blunt spray tip. And again, using that same solution of normal saline and methylene blue, we can infuse this into the submucosal space. Very importantly here-- if you can see my cursor-- on the inferior wall is the patient's mucosal layer.

And you can see the classic appearance of the blood vessels here. And what's critical is that we always keep the muscle layer onto the superior aspect, and the mucosal layer on the inferior aspect, and away from our cutting tool. It's very critical that we maintain the integrity of the mucosal layer. This prevents the risk of infection or fistulazation.

As you can see in the right frame, we'll just go ahead and continue our tunnel. And this tunnel will need to be extended a good 10 centimeters, so that we extend it all the way down to the level of the lower esophageal sphincter and beyond. And again, we're always attempting to keep these muscle fibers on the superior aspect. This is the portion that's going to receive the myotomy once the tunnel has been completed.

Once we've extended our tunnel, we look for landmarks that indicate that we have reached the terminus. And by the terminus, we mean that we are able to dissect just past this thick muscular lower esophageal sphincter here, and extend our myotomy another three or four centimeters into the gastric cardia. And we begin to look for landmarks, based on the appearance of the blood vessels, and the ease of which we can pass the bevel tip back and forth across this plane. We're actually able to see the inside of the gastric mucosa layer, and distinguish it from the esophagus. So this brings us to the tunnel terminus. You can appreciate the length of the tunnel that we've created as we back the endoscope out.

Once we've removed the endoscope from the tunnel, we can reinspect and then go ahead and reinsert. You can see in the clip on the right side here, that once we've gone through, our blue dye has extended all the way to this level. But you can appreciate that it's still difficult for the endoscope to pass through, because the

myotomy has not been constructed. And we'll see some of our methylene blue dye that has dissected into the gastra cardia mucosal layer here.

And continuing on, again, we'll confirm that good methylene blue dye is extended to and beyond the layer level of the lower esophageal sphincter, and then confirm that endoscopically. So there we know that our tunnel has been complete. Then we could withdraw back to our entry site, and reinsert the endoscope, and we can initiate our myotomy at this time.

The beginning of the myotomy is done, using again, the spray coagulation with the TT knife. And here you can very nicely see how using spray coagulation, we have disrupted the circular muscle layers. And you can see these very fine longitudinal muscle fibers that make up the outside of the wall. Once we've entered into this space and dissected it, then we can use the TT knife to grasp those fibers. And using the endocut mode to very precisely, very intricately, dissect these muscle fibers. And this process will then continue for a full 8 to 10 centimeters down the length of the mid to distal esophagus, the lower esophageal sphincter, and the gastra cardia.

So in contrast to the pneumatic dilation, this is a very precise means of dissecting and cutting the muscle fibers, in contrast to a blunt force tearing. Here you can see, in the screen on the right, that despite our efforts to perform purely a circular muscle myotomy, that sometimes the fibers will split. And this structure that you see beating just beyond the screen represents the pericardium and the left atrium. So you can see that we're in a busy area. And, of course, that's why this requires such a degree of precision and excellent visualization as we extend the myotomy.

Important to the success of the procedure is ensuring that the myotomy is complete. It's no good to achieve ineffective transection of the lower esophageal sphincter. And so it's very important to recognize the anatomy in this area, and to ensure that the myotomy has been completed. And we do this based on the visual appearances of the muscle and the surrounding tissues, but we also then do it by removing the endoscope from the submucosal tunnel, and confirming that the endoscope an cap are able to now move very easily back and forth across that lower esophageal sphincter that forbid the passage in the pre-myotomy attempts.

Once we've ensured that we have achieved the complete myotomy, we use

standard endoscopic clipping techniques to seal our entry route. So these are standard endoscopic clips that are used for treatment of bleeding or to close endoscopic resection sites. And generally, we'll use anywhere from six to a dozen or more of these clips to achieve a completion closure.

Post-procedure-- if the patients are awakened from anesthesia and extubated, we ask them to remain nil by mouth for the first evening. They are observed in our 23-hour observation ward. They're administered prophylactic intravenous proton pump inhibitor for acid suppression. And at 8 o'clock the next morning, they undergo an esophagram to confirm that there's no leak, and that there's effective passage of the ingested contents. And then we prescribe an incremental dietary advance.

So they get a tray of clear liquids. Once they tolerate that, they're discharged to home. We ask them to remain on clear liquids for the first day. The next day they're asked to use full liquids, so smoothies and milkshakes and the like. For the next two days they're on a soft diet. So scrambled eggs, mac and cheese, mashed potatoes. And then on the day five they resume their regular diet. They are provided some analgesia as needed, although that's infrequently used. And we see them back again for an esophagram and follow-up visit in the clinic in three weeks.

So with that, I will conclude the formal part of this presentation. What I've tried to do is review the presentation and diagnosis of achalasia with you. I've describe the endoscopic an operative management options for patients with achalasia. And I've introduced you to the POEM procedure, per-oral endoscopic myotomy as a treatment for achalasia. And I've talked to you a little bit about how we've effectively introduced to a new and novel procedure through a multi-disciplinary collaborative approach here at Penn Medicine. Thank you.