

[MUSIC PLAYING]

**SPEAKER 1:** I was asked to present conduit revisions. And essentially, reoperations are very technically challenging. And I think I have an interest in reoperative surgery myself. I believe the conduit revisions are probably the most difficult of the reoperative procedures and we have to be very careful in selection when you consider this patient for reoperative services. So basically, I want to go over some of the highlights and give some technical tips of how to proceed with these operations.

So how can we best use the stomach to function as an esophagus. And that's what we want to achieve, normal conduit that functions the best actually as an esophagus. Does gastric tube function better than a whole stomach? Maybe most of us nationally probably use a whole stomach, but is there a data out there supporting that gastric tube functions better.

And how do we identify a malfunctioning kind of conduit? And how often does that happen? And do we need to operate on every one of them? Can gastric conduits be revised to be more functional?

And I would show you that in some situations that is possible. Is there any data to support that? Not much. Basically the data out there is single institution, clinical papers, or case reports for these types of procedures.

So the ideal conduit is the esophagus. You have to look for potential for leak, ischemia, and strictures, but you want to have the ability to swallow normally afterwards, you have an ability to eat a normal diet, maintain your weight, and hopefully be free of some reflux. After doing resection, you have to be freedom of local currents. And then look at durability, short term durability and long term durability. So how do you how do you evaluate when you see a patient who's miserable after an esophagectomy?

Selection, we kind of went over this probably earlier. Whole stomach was a gastric tube and colon conduit. For the most part, most of these two institutions are using stomach as a conduit as the initial choice. But other options are available.

The reason why is because it's a smaller operation. The leak rate is probably lower. There's one in anastomosis you're supposed to use in a colon. These are the various locations. Usually we use posterior mediastinum as your initial choice. And substernally when you're doing reoperative surgery for conduit placement.

So stomach, as I mentioned and whole stomach, as I mentioned, is the most common choice as a conduit. And you can see that in terms of technical aspects of it you have to be based on the right gastroepiploic. You take the short gastric, left gastric. The survival of the fundus also depends on the submucosal channels that are there, present. So we stress the need for careful handling of the stomach, especially in that location. And we know that leak risk is higher based on data that's reported when you go higher up the neck, although easier to manage.

The benefit of stomach as opposed to colon when in anastomosis, but the downside is that it's a reflux operation. So you're putting an anastomosis between the esophagus and the stomach devoid of any valve mechanism. So therefore it will lead to reflux eventually. In fact, over time even though it's denervated, after a year, two, or three years it will start to make more acid. We know that based on some animal studies.

Based on whole stomach, one of the largest initial experience by Aungers is published. You can see here that in late functional results in their paper when they looked up benign cases, the patient lived longer.

The functional results from Goods Brexton were about 70%. There's a lot of patients out there, 30% maybe more, that had poor functional outcome later on. So some of them are managed medically, some of them are managed with endoscopic measures. But few of them may require conduit revisions.

This basically goes over gastric tube construction. And we feel here at UPMC that the gastric tube is more functional. And I'm sure you heard Dr. Luca mention that earlier. But also there has been data and reports out there in the literature that it does function better in terms of gastric emptying as opposed to whole stomach.

And here you can see the downside of gastric tube is collateral blood flow. So the leak rates or ischemia rates may be a little bit higher because you're devascularizing some of the stomach. So that's certainly a concern. And I will go over a little bit about that.

Other things, you can achieve better margins if you use narrow tubes, and you have various options available. But the important thing is also the gastric tube as whole stomach is denervated, which is a main reason why you will have delayed gastric emptying after esophagectomy and conduit formation. We're not going to go with that, going to skip over that just for the sake of time.

But here you can see in terms of our initial experience of 222 patients looking at gastric tube and quality of life. And with a narrow gastrectomy construct at about 5, 6 centimeters in diameter. You can see an amine follow up at 19 months. Disphages for [INAUDIBLE] HRQL tool used to measure reflux showed no reflux with a narrow gastric tube. The physical and mental component scores also normal.

So one of the conclusions that we made from that paper, that the quality of life is preserved after MIE with a narrow gastric tube. However, as you know, cancer patients may not live five years out. But if you do an esophagectomy and gastric tube construction for benign disease you'll start to see some of these problems later on further out your go from esophageal reception.

And here you can see that in our own experience in the same paper when we transitioned to a narrowed tube from 6 centimeters to 3 or 4 centimeters, we saw the leak rate was significantly higher with a narrow tube. 27% versus 6%. So in emphasizing the fact that, yes, you want to make a narrow tube.

But also understand that you may have a higher leak rate. So you have to become somewhat of a compromise here. So we know based on the quality of life that a narrow tube is function better. We also know the leak rate is higher when a really narrow tube. So we adopted the 5 centimeter, 6 centimetre gastric tube which, in our opinion, functions better.

So we gathered from our experience here that narrow gastric tube seems to preserve quality of life and more functional. The idea of the diameter may be 5, 6 centimeters to minimize leaks. And so our philosophy here is to make a narrow tube as opposed to use the whole stomach. And you can see that the quality of life after whole stomach long term of a benign disease may not be as good.

Here's a schematic that lets you see how the tube is made. And we kind of went over that earlier. But essentially, technically, you're tracking here, here. You're stretching the stomach using 45 loads. It's slowly marching along parallel instead of greater curvature.

At the end of your operation the conduit should look like an esophagus. If it doesn't look like an esophagus, well, it probably will lead to some malfunction. It may not be evident six months later, or a year later but if you're doing it for benign disease or early stage esophageal cancer, you'll start to see conduit malfunction later on. So a nice high anastomosis, straight gastric tube with an antral reservoir, pyloric drainage.

So based on physics the narrow tubes tends to not dilate with swallowing. So it tends to empty with gravity better as opposed to whole stomach which may lead to stasis.

So the mechanical problems that we may see with conduits are many. And basically, could be an atonic stricture, it could be dilated within a herniated conduit, could be torsional conduit not recognizing on the index operation when you bought the conduit up that it was twisted. Tight cloral closure, lack of pyloric drainage, or as one of the talks will mention, the paraconduit hernia. These are all potential problems that you may have from gastric conduit malfunction.

Some of the clinical symptoms are obvious. You can see it related to reflux, regurgitation, secondly stasis, aspiration, aspiration pneumonia, sometimes the PFT trends start to get worse over time, early satiety, vomiting, dysphagia, pain, and bloating. These symptoms may be managed with medical therapy. It's when they start becoming intractable to medical therapy that we refer these patients to manage potentially for conduit revision.

So the evaluation has to be very thorough and detailed. So it always starts with a good history and physical evaluation of patients. Overall symptoms, how they evolved over time after esophageal resection.

You should always review-- don't rely on record, but review all the prior records and pathology. And identify how the symptoms have evolved over time. It may be better for a year or two, but then certainly they start getting more regurge, more satiety, more pain.

Have they received appropriate medical therapy? Don't jump into a conduit revision right away. On PPIs make sure they have dilation therapy. And subsequently, if they were a cancer patient, you have to make sure they're at least cancer free based on your initial clinical assessment before you embark on a journey of a revision of a conduit.

Diagnostic assessment has to be very thorough. All of them should have a barium esophagram, a CAT scan. And endoscopy should be performed by the surgeon to look at the overall assessment of the mucosa. We always try to get other additional objective tests in to document some type of malfunction, the endoric dysfunction like PFTs, get nuclear studies.

You want to have a backup plan to look at the colon as an option if stomach is not usable. So colonoscopy, and CT and geography are also essential and critical if you're going to move forward with surgery.

Moving forward, we'll kind of go over some of the schematics here. And you can see that in this image here, this second image of lack of pyloric drainage over time, the conduits has dilated over time due to an obstruction at the pylorus, the radiograph that showed a similar finding.

Now, this picture to me looks like end stage achalasia. So end stage achalasia, as you know, is managed by either myotomy or other esophageal resection. So there's the same kind of look to it. So you can how other patient may be miserable over time.

Here you can see that at the initial operation the conduit may be brought up too much. And one of the technical things that I think we also see that if you enter the left pleura early or do an index operation, you may have the conduit kind of fall into the left chest. So important at the time that maybe you want to pull it down, or you maybe want to put a chest tube on the left side to get a good lung expansion, but that's certainly a possibility. If you recognize this and post-operatively try to fix it at that time prior to discharge, and I think you'll have a better functional outcome.

Here you can see the conduit is twisted on the schematic. And remember when you bring it up, staple lines should be facing you. If it's not, then there's some torsion to it. You could also look at a scan and see the staple line is oriented properly and not properly. So you'll give you some insight to what's going on. But clearly the endoscopy is the most telling when you have a conduit twist like that.

Here this image shows you a very tight cortical closure. Again, same look as an achalasia patient. So you see how the patient would be miserable during meals or [INAUDIBLE].

Diaphragmatic hernias are also possible. And I think we'll reserve that for the other talk that'll be given on for [INAUDIBLE] hernias. Redundant conduit in hernias can be present in the same patient.

So the images are also critical and give us a lot of insights, but we don't operate on images only. We operate on a patient's clinical symptoms. So if the patient's clinical symptoms are real and tractable with good objective documentation on the imaging, you have an opportunity to make that patient better.

Surgical correction will lead to the best outcomes in patients who have severe intractable symptoms. The patient is going to be miserable when they come to your office. And failed medical therapy, and also there's good correlation with objective testing.

Just to go over how do you prevent this problem. And I think we talked about prevention earlier. I think Dr. Lucas may have mentioned this also. But really, it's the index operation. You want to try to construct a narrow gastric tube. You tailor the closure of hyoid space in the conduit diameter.

But critical, avoid pulling up too much conduit in the chest, especially if you're doing Ivor Lewis. When you're doing the McKun approach you are there and you have the conduit in the neck, but you also can see from the abdomen you can make some adjustments and close the cortical closure. But when you're doing Ivor Lewis it's hard to envision that. I think putting in stitches there helps and trying not to bring up too much conduit.

Attack the conduit to the highest. Ensure there's a proper orientation before you make the anastomosis. And personally, I think pyloric drainage is appropriate, although a lot of conflicting data what side of the fence you believe in pyloric drainage now. But I think pyloric drainage definitely helps in terms of conduit emptying.

So what are the surgical corrections they can make? Well, they could be very simple to very complex. Conduit aversion or convert operation can be just basically drainage, like pyloric drainage or open up the cruise. Or you can repair the [INAUDIBLE] hernia. Or other approaches that are a little more complex are the laparoscopic and thoroscopic reconstruction of the gastric tube.

The tube is very wide. You can make it narrow, if you identify based on the assessment, and that's the main problem. And then really complex is when you have to disconnect sometimes, and reanastomosis in the same setting. Or diversion, you have to divert the patient cervical esophagostomy G tube and then come back in three to six months later and reform the gastric conduit. So it could be any spectrum of this operation to give you a good functional result long term.

Operative planning has to be very thorough and complete. It should give you some guidance as to the type of operation approach that you want. Whether you do chest, belly, chest, or just chest or belly. So I think you'll have some type of plan prior to surgical intervention.

And then the back up plan is, what are you going to do if you can't use this stomach and you're using the colon? Or are you going to abort the operation? I think you'd have to have all this done based on your pre-operative clinical assessment and also assessment doing the objective testing and radiographs.

And I think it's important that you don't take this patient to the OR the first office visit. I think this patient should come back to you over months and months to talk about the operation and see if they really want to move forward with this. Because certainly there's a lot of morbidity from reoperations.

In terms of technical parts of it, you should have an endoscopy, whether it's before or on the table. Normally we try to start with the VATs or thorcotomy based on your experience. You can decide in the chest whether the conduit can be revised in the chest by making the tube more narrower on the chest or does it need to be disconnected. So those are kind of critical decisions you're going to make in the operating room while you're in the chest. And then once you've decided that, whether you've completed the operation in the chest only or you have to go in the belly and do further mobilization.

Do you finish in the belly, or you go back in that chest and then reconnect and reduce it? There's a lot of things you have to have and a lot of things to think about when you are revising. Because certainly if you're going to do the surgery, you have to make sure the patient has a functional outcome.

Technical pearls, and I mentioned to you in the chest, basically you have to be careful of the blood supply, obviously. Work was easy and VATs open depends on your experience. If you feel comfortable with the VATs, it's fine. If you're not comfortable, you go open.

You've got to identify the airway. You can use doppler. And I think using a penrose around the conduit is better because you don't damage the conduit as much. You can grab the penrose and move it around. So I think kind of limits your damage to the conduit itself.

And certainly you have an option if things are really ugly, you can abort. You don't have to complete the operation if you think there's a danger to the patient. So certainly these are the things that you'd be thinking about while you're doing a chest.

Once you've done the chest part and you feel like you go to the abdomen and the belly, again, the same decisions. Laparoscopic open. And the key part in the belly is when you're there you identify the posterior stomach. Once you identify the posterior stomach you know that you're behind the arcade. So you're in a safe zone now.

And I can follow that stomach posteriorly and do some more work. And that's a critical part as far as I'm concerned in terms of conserving the blood supply. Identification of cortical lobe is important for the cortical mobilization, certainly for these to sum it up. Technical steps you have to be thinking about when you're doing the chest portion or the belly portion.

Just to kind of shift some gears. A case that I did about a year ago. This is a patient who was a 57-year-old. Just to show you when you consider somebody for reoperative conduit surgery. She had an open surgery done in 2013 for hyoid dysphasia, and outside institution. She had intractable foregut symptoms, as you can see.

CAT scan, upper GI all showed redundant conduit. Gastric emptying also showed a lack of clearance, 90 minutes from the stomach. UD had a very low anastomosis and a sigmoid conduit, so it all indicates malfunctioning conduit. Also her PFTs were poor. They were kind of getting affected because of chronic aspiration. This is a preoperative image, as you can see, how much fluid and debris is in the conduit here.

This is the barium swallow. It shows the conduit dilated. And here you also see a different view.

And basically at the time of the initial visit it took about six months for the patient to go to the OR. So it's not like we make a decision right away. We did quite a bit of work up. And finally, she actually underwent an esophageal diversion on the index operation, spit fistula, which took about three months, settled things down. She felt better, nutritionally sound.

We conditioned the stomach for about three months, brought her back in, did a substernally pull up. And this is a post-operative swallow. You could see that's not a great image, but you may be able to see a video here. It's kind of horizontal. Not a great image, but the important thing is that we didn't do the operation right away.

She never leaked. We gave the time for the stomach to condition. We waited up to three to six months to kind of bring her back and do a substernal, and she had a pretty decent outcome. Now she's able to eat a soft diet, maintain her weight.

What's in the literature? Not much. This is an example of a case that was reported--

**AUDIENCE:** Excuse me, did you use the original stomach [INAUDIBLE] to go back?

**SPEAKER 1:** Yeah. When we diverted her the stomach was not suitable to be used at the time because of the trauma during the operation. So we put a G tube in. We conditioned it for about three months.

**AUDIENCE:** G tube or J tube?

**SPEAKER 1:** G tube. Gastrostomy tube. And that allows us to get some bowel feeds. The stomach kind of was conditioned over about three to six months. And then we were able to use the stomach also as a conduit by making it a more narrower, more functional.

**AUDIENCE:** You were able to take the whole stomach back down.

**SPEAKER 1:** Right, correct. But you have to-- there's a lot of pitfalls. It's not easy. You have to really preserve the blood supply. You have to handle it with care.

The critical issue as far as I'm concerned, the operation was not to connect the patient back the same time. If we'd done that we probably would have a gastric dip necrosis and probably would have taken it down anyway. So we decided at the time that it was very long, 12 hours. Let's put a G tube in the stomach, in the belly, and then condition it. Bring her back three to six months later and then reconnect her pap.

So this is a case report. As you can see here, this child had esophageal atresia and was struggling from year two to year ten with swallowing and GI symptoms. Symptoms became progressive with pain, dyspepsia, cough, halitosis. You can see the lie the colon is more horizontal. And you can see how this will lead to aspiration, early satiety, pain, reflux.

And in 2006, as published by Glass, you can see here what they did in this case was basically they did thoracic incision, a chest incision. And they mobilized the colon from the thoracic inlid to the diaphragmatic hiatus. And they're able to preserve the blood supply. They did a limited resection, made it more functional. All the redundancy of the colon, they removed and they reconnected it back together.

So post-surgery at 12 months the child was able to eat regular diet and had no dyspepsia, improved overall clinical symptoms. So there's some data out there for these revisions that are done.

Here you can see in 2006 Shindel basically reported two cases of four patients who underwent a esophageal resection via the Ivor Lewis approach. And one of the patients had access blind limb of the gastric conduit and a very low anastomosis. The other patient had a very redundant stomach with a transverse orientation and a low anastomosis.

And on the schematic you can see here as the patient was eating some of the food was going down here, down the conduit. And it's pretty low in terms of where the connection was. After the surgery, this was what they basically wanted to accomplish. They just amputated the excessive gastric blind pouch.

The second patient you can see is more of a challenging case because this is more a low anastomosis and a sigmoid loop. And you can see in this situation basically they had to do a chest approach to mobilize everything. Then they need to go in the belly and to resect this. And basically refashioned in that gastric tube in the belly, and did MacCuen, do a neck anastomosis. And ultimately, you can see this was the looked to, at least on the schematic, and much more functional.

So as you can see, this is not going to be functional. We're going to have all the debris food sitting there, coming up, patient is going to have a lot of pain, discomfort. And then this, as you can see, is much more functional. So there are some case series reports out there that indicates that these are possible for very select patients.

So in the second patient that I showed the schematic, basically showing that the patient had a esophogotomy in 1983 with hyoid dysplasia. And subsequently developed a horizontal lie on the conduit with a low anastomosis, from 1993 to 2000, and then eventually had a revision in 2000. During this time period the patient developed recurrent hyoid dysplasia. So there was another reason why they went in. In addition to a functional aspect of it and they're revising that anastomosis to a cervical anastomosis in 2000.

So their conclusion was basically patients who have redundant intrathoracic stomach and a low anastomosis with intractable severe symptoms can be reconstructed using a previous mobilized stomach and degenerated with functional outcome after a revision.

Our experience here was published. Michael Kent was one of the fellows here before, you can see. We had 43 patients we looked at. In 2008 it was published. And basically two types of patients, diaphragmatic hernia patients and redundant conduit patients.

And how do we manage these patients in terms of the outcomes. And you can see here that this was a retrospective review. We recorded primarily symptoms of dysphasia, and basically reflux, regurgitation. We looked at outcomes and operative approach.

Of the 43 patients, about 19 patients had redundant conduits as the primary indication. So half of them had redundant conduits, half of them had diaphragmatic or paraesophageal hernias. And in terms of the results, you can see the majority of the hernias occurred on the left side if it was a paraesophageal hernia. 54% of the patients redundant conduit, had mechanical obstructive symptoms in our experience. And 85% of patient symptoms improved after conduit revision.

All those 22 patients in our experience who had a conduit revision, these are the primary symptoms. As you can see, they had a variety of symptoms, dysphagia, regurge, most from mechanical symptoms and from the conduit malfunction. And here you can see the findings of the [INAUDIBLE] findings on the imaging. Excessive conduit above the diaphragm. In 23% of patients mechanical obstructions for various reasons. And a twisted conduit, also, on the pre-operative assessment.

Out of those patients, 20 patients had a minimum invasive approach. 15 had a laparoscopic approach only. Five patients had a laproscopic and combined thoroscopic approach, and two had permitted to open.

So most of these in early experience were approached from the abdomen. Although our approach now is from the chest usually to mobilize the conduit and then do a belly, maybe finish back in the chest. 81% had no morbidity. And three patients underwent early reoperational from bleeding collar thorax and stent for obstruction. And one patient actually died in our series of 43 patients.

In terms of outcomes. At 12 months, 65% of patients had complete or resolution of minimal symptoms, and 20% had improved but persistent symptoms. You can see that some patients were miserable even after a conduit revision, despite conduit revision. So you have to be very careful in selecting these patients.

So what we concluded from our experience that development of redundant conduit may be associated with functional outflow of obstruction. And a majority of patients' symptoms improve after surgery. However there's some select patients, 50% of patients did not have any improvement in symptoms after conduit revisions, so be very careful in your selection.

So functional outcomes. Necessary of proper selection and approach. A detailed work up is unnecessary. So functional outcome becomes important as early stage patients live longer after esophogectomy, so for benign cases or for early stage cancer we have to emphasize more on the functional outcomes for esophageal resection.

Incidents of redundant conduits in gastric conduits is low. So despite having a lot of esophageal resection, very few patients will develop this problem that requires surgical intervention. Probably selected patients who have an anatomic abnormality and a strong correlation, the clinical symptoms may benefit from conduit revision and surgical management.

So the important thing is that you have to have a detailed work up for this patient prior to considering them for surgery. You should evaluate other alternatives, or as a backup plan because you can you stomach. Conduit revisions are one of the most challenging operations and in our opinion should be performed by experienced surgeons at experience centers. So these are not to be taken lightly.

Thank you. So here's, again, the picture of what a conduit should look after a esophageal resection, in terms of the functional component of it.