

**CLAUDIO DEANGELIS:** We determined that the patient need the pancreatic fluid collection drainage on the basis of the clinical state of the patient. There must be symptoms. There must be infection. There must be pancreatic collection that grow very rapidly. In that case, we can decide that the sources of the pancreatic fluid collection should be drained, otherwise, not.

**NICHOLAS CARROLL:** Well, essentially, this is a clinical scenario. And it is all about symptoms, so whether the patient has a feeling of fullness, loss of appetite, right up to gastric outflow obstructions, a physical obstruction to the emptying of the stomach.

Also, pain is a big issue. So whether you have a very painful collection, that's often an arbiter of the need to intervene. And finally, of course, you've got all the stigmata of infection and the declining clinical condition as a result of sepsis.

**CLAUDIO DEANGELIS:** It is a team constituted by the gastroenterologist. That's myself or my co-workers. There is the surgeon for sure, because you need the surgeon in some cases. You hope not to need the surgeon, but in some cases, you need it and the anesthesiologist.

But in some cases, it is not a matter to decide to treat or not to treat. It's for the management or the patient, you need a [INAUDIBLE], but not for deciding the management of the [INAUDIBLE] system.

**NICHOLAS CARROLL:** We do work in multidisciplinary teams. Essentially, our multidisciplinary team is based around pancreatic and biliary cancer. So therefore, those people with benign conditions, such as advanced difficult stone disease in the bile duct or pancreatic inflammation, tend to be tacked on, if you like, to the cancer MDT forum, because you've got all the right people in the right place.

There is a need, I think, for a multidisciplinary meeting of its own. But of course, we're all completely timed out on meetings, so it's very difficult to do that. But I think it's essential that you have a coordinated approach from the surgeons, physicians looking after the patient, interventional radiology, and intervention endoscopy to get the right technique to the right patient.

**MARK ELLRICHMAN:** We present every patient that comes with abdominal pain or acute pancreatitis in our multidisciplinary conference. Together with the surgeons at the intervention, the radiologist and, of course, assess the interventional endoscopist and gastroenterologist. We discuss every single patient and have a CT scan, have all these examinations available. And then we decide which is the best approach to this pancreatic fluid collection.

**ILLARIA TARANTINO:** Yes, this is team working for sure. We have a dedicated group. It's a pancreatic group done by surgeons, EUS endoscopists, radiologists, and pathologists. So we discuss the case all together to make the best decision on the patient.

**CLAUDIO DEANGELIS:** This seems to be an easy question, but it is not so easy sometimes. For sure, if you have a patient that has acute pancreatitis, and you have some imaging modalities before, and you don't have cysts, it's easy to say that the collection is after the acute pancreatitis. So it is pancreatic fluid collection and not an mucinous cystadenoma or someone like this.

In other cases, it's not so easy, and you should use the data that morphology can give you. There's CT morphology, MRI morphology, EUS morphology and sometimes, in very difficult cases, you should puncture the cyst before the drainage in order to have some information about the cystic fluid.

**NICHOLAS CARROLL:** We used to beat ourselves up a lot about this. We used to do a needle aspiration of pancreatic collections prior to doing any form of intervention and send the fluid for analysis, for CEA, for amylase. But generally speaking, the clinical conditions are completely separate and identifiable.

However, I think, if you have any doubt-- and we did have a case recently. We had a large multi-loculated cyst within a pancreas, which had evidence of chronic pancreatitis. We did do an aspiration of that case first before we went ahead and did a gastrocystostomy, purely to prove that this wasn't a mucinous tumor.

And we do see them, so the last thing you want to do, of course, is to drain a mucinous tumor. So yes, I would say that if you have any clinical doubt or any doubt based upon the radiology, I would suggest that you do a diagnostic aspiration. Of course, as soon as you go into a collection that may have been sterile before, you have contaminated that collection. Therefore, you're almost committed to doing something about it.

**CLAUDIO DEANGELIS:** I must tell you that for many years, we was between the first in the world to drain endoscopically pseudocyst and pancreatic abscesses. And we have a big series in 1994, so at the very beginning of this history. And in the first the 20 years, we didn't care about pancreatic disruption.

But today, we know that it is important. It is important because if you have pancreatic disruption, the severity of pancreatitis can be worse. And if you have pancreatic disruption, you can have a more complication. And for sure, the rate of the resolution of the drainage can be much worse than in the case you have a good pancreatic duct anatomy and morphology.

**NICHOLAS CARROLL:** I personally don't think that we pay enough attention to it, or maybe we don't need to. It's a difficult one to gauge. Clearly, patients who develop large fluid collections-- and I'm not necessarily talking about walled-off necrosis now, I'm talking about those simple fluid collections.

And we have a number of cases, where you think, this a simple, pseudocyst. We'll drain it. It's not very clear either from the MRI or any other imaging prior to that because of the size of the cyst. We can't see a connection with the duct. You drain it, and then of course, it immediately reforms as soon as you take a stent out. And that's clearly a disrupted duct.

But we still need to do something about them. So I'm not sure it particularly influences our initial management. I think it's something that perhaps we need less concern about really.

My advice more than anything-- I don't want to sound like I'm preaching to people-- but I think that my advice is to make sure you're absolutely certain about your position before you start. And I tend to use the technique, where I don't just find the cyst and think, great, we're there. Let's go. Let's do it. Let's plug it in. Let's go.

I will go deliberately beyond the cyst, and then come back, and then analyze position from a number of different places within the gastric lumen or duodenal lumen, for that matter, wherever the cyst is to try and gauge where is the best place. And I will practice the maneuver. I will check my endoscopic position. I'll go back to the EUS image and go backwards and forwards until I'm happy I've got the best, where I've got the best EUS image and the best endoscopic image.

The other thing, of course, is make sure you're not too proximal. It's very easy to come back, further, further back. You're looking at the EUS image, and you're not looking where you are. And if you approach the Z-line, you're approaching the gastroesophageal junction. I think you're going to be in trouble. You certainly want to go above the diaphragm. So you know, I think it's very good technique to go beyond the problem and come back slowly, keeping an eye on your endoscopic position. And just as I say, go backwards and forwards, and check the best position of all.

**MARK ELLRICHMAN:** You have to plan your procedure quite carefully. You have to look for vessels at the site you want to puncture and especially at the contralateral side of the wall. Because when the wall completely collapses or the cavity collapses, then you can have severe bleeding from the contralateral wall. That's what you have to watch out for.

You have to look for the size of the pancreatic fluid collection. And the size, if it's a rather large one, or a quite proximal one close to the gastroesophageal junction, then we always would do it under general anesthesia. If it's a smaller one and a more distal one, then conscious sedation would be enough. But when you start, always general anesthesia just to get accommodated to the procedure.

**ILLARIA TARANTINO:** Well, the most important thing, I think, is that you have absolutely clear that you have to take your time to choose their best point to do the drainage. This is the most important thing, because you have to avoid vessels, and you have to choose the best point to deploy the distal phalanges where you have liquid content.

**CLAUDIO DEANGELIS:** When I start a procedure like this, with a mind to drain the pancreatic fluid collection and to perform, if necessary, necrosectomy, we have, for sure, in the room an operative EUS scope and a duodenal scope, and an operative gastroscope. These are the two instruments we used to have in the room for using in different kind of situations.

And we also need to have guide wires, for sure, of different types and cystotome, and EUS needles, and plastic stent. In some cases, we need plastic stent, and nasocystic catheter and, I think, all the accessories we have in a biliary room.

**NICHOLAS CARROLL:** Well, we don't do a routine endoscopy first. We go straight to using a therapeutic echoendoscope with a decent-sized working channel. I do have the patients placed on a screening trolley so that I have the ability to do screening if necessary. But with freehand hot AXIOS, we have not had the need to have a screening presence. We're not using a wire traditionally, however, I do have that facility available if I need it.

So if we lose position, if we need to revert to a more conventional technique, I think it's sensible to have the ability to go back to screening if you need it. So essentially, all I would require is a good echoendoscope with a decent working channel, a screening trolley, and set up in the all the right configurations to get the best view.

**CLAUDIO DEANGELIS:** The vast majority of our patients were done only on deep sedation and not general anesthesia, not with intubation of the patient. But in some cases, if the patient are as are 3 or as a 4 and if the pancreatic fluid collection is bigger than 15 centimeters, you can have a lot of fluid coming into the stomach, with the risk of aspiration. In that case, we prefer intubation and not only deep sedation. But in the majority of the cases, we use only deep sedation with propofol. The patient position for us is on the left lateral position and sometimes, the prone position. But the left lateral position is the position I prefer.

**NICHOLAS CARROLL:** This is a big problem in the United Kingdom. Unlike, I think, most of us in Europe and, certainly, the United States and parts of Australasia, we do not have easy access to general anesthesia. And we certainly do not have easy access to propofol, deep sedation.

We have conscious sedation is really our traditional and standard way that even complex procedures are done in the United Kingdom. This is a problem where you need patient stability, you need less movement, you need less coughing and belching. It's a very big problem.

And I am working at the moment, and I know George Webster-- it's a university college hospital in London-- has been doing quite a lot of work looking at propofol, deep sedation supervised by either an anesthetist or anesthetist assistant in order to improve compliance. With freehand hot AXIOS, we have shown that, actually, it's such a simple easy procedure to perform that yes, it's fine. You can do it under conscious sedation.

But of course, then you have the problem of an unprotected airway, with large amounts of quite dangerous fluid suddenly flooding into the stomach. And any vomiting and aspiration would be a disaster. So although it's possible to do under conscious sedation, if I had a preference, I would prefer to do it with full airway protection and full anesthesia.

Conventionally, of course, most endoscopy procedures are done with the patient left side down. So it's called left lateral decubitus position. And that's a traditional endoscopic approach.

I find, actually, that increasingly with using the big therapeutic scopes and for positioning of various anatomical structures during procedures, I find putting the patient in a semi-recumbent or ERCP position, so-called swimming position, I prefer that for these procedures. And this has become particularly relevant when looking at gall bladder drainage, where it brings the gall bladder nicely against the antrum of the stomach in that position in my experience.

**MARK ELLRICHMAN:** On the left side, definitely. Always on the left side. Then we normally don't do it under general anesthesia, but normally, about 80% of the patients and just conscious sedation.

**ILLARIA TARANTINO:** We do all the pseudocyst drainage and necrosis treatment on general anesthesia, just because our anesthesiologists prefer to have the airway protected from eventual [INAUDIBLE]. And the patient is always in supine positions.

**CLAUDIO DEANGELIS:** The content of the cyst is the main problem that we take into account in order to decide if you can use the 10 millimeters or the 15 millimeters stent. Because if you have a big cyst, but only with fluid content, I would prefer the 10 millimeters stent. Because I don't want to have a lot of fluid very rapidly coming into the stomach or into the duodenum because of problem of aspiration. So I would prefer the 10 millimeter stent. If I have a lot of debris or the fluid is very thick, I would prefer the 15 millimeters stent.

**NICHOLAS CARROLL:** That's a very good question. And I think most people say, the larger, the better. I think, traditionally, hot AXIOS, of course, is difficult for us to purchase, except on a case-by-case basis. We can't preorder. So we tend to really go for the 15 millimeter for most pancreatic work. I don't see the point in using anything smaller, particularly if you have any evidence at all that you're going to have to do some form of necrosectomy.

Some people-- of course, 10 centimeter, I think, it's an option. But at the moment, we found the 15 millimeter AXIOS is perfectly acceptable for us. If we're going to use biliary work, of course, then obviously, we're going to have to look at different sizes. I was intending to use the 8 millimeter, though, I heard last night that 10 millimeter may also be satisfactory.

**MARK ELLRICHTMAN:** Regarding the pancreatic fluid collection depends on the content. If it's just the liquid content, we use the 10 millimeter diameter, and if it's a liquid, plus solid content, with a lot of debris in it, then we use the larger one, the 15 millimeter one.

**CLAUDIO DEANGELIS:** You must be able to do all the procedures we perform before having this type of stent. And so also, I think that could be better to have the radiology in the room in some cases, because you don't need it for position the stent.

But if you have problem, it's better to have the radiology in the room. And you must be able to perform all the old procedures that we used to perform in these cases. So I think that it could be better to have a background and not to start-- a big round should be a big round of pancreatic fluid collection drainage, a big round of pre-operative ERCP and a big round of interventional EUS.

**NICHOLAS CARROLL:** I think, because we're doing this in a multidisciplinary format, obviously, people know what we're doing, I do warn surgeons if we're about to do something in a patient where I think there's any chance of significant complication or problems in the follow-up. I tend to bring in the patients under the surgical team just for the logistical point of having junior staff available to look after the patients at night.

Although, I have admitting rights whether I'm a consultant radiologist. I do have admitting rights because I work within gastroenterology. But it's just simple for me to use the surgical teams. So therefore, they're in the right setting. And also, it's not just the clinicians, it's the nursing staff, the whole team-- the dietitians, et cetera-- after the operation are all keen into those beds. So therefore, the patients will get the right post-procedural management in a surgical unit.

**MARK ELLRICHTMAN:** We always have the interventional radiologist on-call and the surgeons. And they know about the patient anyway. And we tell them when we do the procedure, and then they're always on-call.

**ILLARIA TARANTINO:** Yes, for sure, the surgeon should be in the hospital or on-call for any complications which can occur.

**CLAUDIO DEANGELIS:** We decide that the patient can go home and be discharged from the hospital when you can be safe about the stent is well-positioned, is stable, and the pancreatic fluid collection that is well-reduced in the diameter. And you don't have a fever. You don't have pain, of course.

**NICHOLAS CARROLL:** All our patients will come in overnight because they will be starved overnight. I don't think it's sensible to feed patients because of peristalsis, because of the potential for vomiting to displace the stent early in its dilation. I mean, obviously, most of the dilation happen straight away, but there will be some slower dilation over the next 24 hours.

So there's no real science about that. But I think it's sensible to keep people nil by mouth. And then we keep them overnight. They have intravenous antibiotic prophylaxis on the ward. And then if there's no complication, they'll go home the next day.

**MARK ELLRICHMAN:** We always admit the patients. That's a general rule. They come via the emergency department. As I said, we have the interdisciplinary conference, then the intervention. They at least stay for one night in the hospital after the intervention, probably longer.

**ILLARIA TARANTINO:** Well, normally, we do the first procedure when we do the drainage and we put a stent. With the procedure-- just in-inpatient. And the other procedure after the second or third session of the necrosectomy, if the other sessions are needed, we can send home the patient if the critical condition permits.

**CLAUDIO DEANGELIS:** Take too much time, not for the position of the stent, but before you look at the position of the fluid collection. You do EUS, and you study the situation. And if you have only deep sedation, you cannot go too long with the time of intervention. In that case, we put the stent and then return to the patient in a second procedure in two or three days.

We used to irrigate the necrosis with hydrogen peroxide, H<sub>2</sub>O<sub>2</sub>, diluted 1.5%. And if the necrosis is infected, we try to eliminate or debris inside the cyst. And this can take about three to five sessions, depending of the dimension of the wall of pancreatic necrosis. In that case, you can perform the session every two or three days in my protocol, not the every day. I think it's too much weight for the patient.

**NICHOLAS CARROLL:** Generally speaking, if we do a 15 millimeter hot AXIOS, we will say to the patient that their fallback is reimaging in four to five weeks and then removal of the stent in six weeks. That's our standard procedure if nothing else goes wrong.

However, we all know that if there's any solid necrotic material, it will usually block the stent. So what we do is we say to them, as soon as there's any evidence of a temperature or any increasing pain, we will get them back and do a simple endoscopy to make sure the stent is patent.

And at that point, you often find necrotic debris in the lumen of the stent. You remove that, and I tend to use the three-pronged grabbers, which I find very useful. I tend not to use rat-tooth grabbers at that stage, because when you're dealing with the lumen of the stent, you can get caught in the stent very easily.

The other thing I do is a lot of irrigation, a lot of suction, just to try and get it cleared. Once I've cleared the lumen, I will then go into the cavity. Now this is the point where people stray into what's the right thing to do and what's not.

Some of my surgical colleagues feel there's absolutely no need to debride that cavity and make it look like a beautiful pink cavern, and it's OK to leave necrosis in there. I think, to a certain extent, what I would try and do is remove anything that's absolutely loose, that's likely to come back and straight away block the lumen. So by a combination of flushing and gentle manipulation with a three-pronged grabber, I will remove everything that looks like it's about to come out anyway.

I do not think it's necessary to go in and start pulling off things which are adherent. I think that's risking bleeding and making it into quite a complex procedure, which I'm not sure is necessary. But I'm not sure everybody would agree with that.

**MARK ELLRICHTMAN:** After the next procedure, approximately three days afterwards, we do the second-look procedure. We start with irrigation with sterile saline. And afterwards, we do the debridement with several devices. Normally, it's a snare or a basket, and that works perfectly well in most of the cases.

Just in case you have very solid material attached to the wall of the cavity, then we place in the second procedure a nasogastric tube, an irrigation tube in there for another three to five days.

**ILLARIA TARANTINO:** As you tell you, we start with hydrogen peroxide irrigation, and then we continue with mechanical debridement always when there are solid components. And we continue as much as possible the [INAUDIBLE] to finish the debridement during the first procedure. When the procedure is too long, we do necrosectomy after one or two days, and then continue in this way.

During the first procedure, we perform mechanical necrosectomy. And starting from the first procedure, we use hydrogen peroxide-- 60cc, with 40cc normal saline. And this is because this irrigation allows us to make the procedure easier for the next session.

**CLAUDIO DEANGELIS:** Yes, if the stent doesn't open completely and in the case in which the wall of the pseudocyst of the collection is too hard, you can see very well that there is a structure in the stent, we used to dilate it to the maximum 10 or 15 millimeters. And the risk is to dislocate the stent, but if you are careful, this is not a real problem. You can dilate, and we used to dilate.

In some cases, the stent dilate itself, not completely in the very first minutes, but quite completely. In that case, we didn't dilate, because we think that in one hour, it could reach the maximum dilation.

**NICHOLAS CARROLL:** I think people say-- and this is general agreement-- that if you have evidence of definite solid necrotic material within the cyst, you should really dilate that lumen up as much as it will go with a 15 millimeter balloon or whatever. My feeling is that if you'd start dilating stents, you are breaking their mechanism. So I think we have to be a little bit cautious about that and trust the stent, to a certain extent.

And if you're worried about the lumen being a problem, then go up to a larger diameter. But I'm not certain that it's wise to over-dilate stents, because they have a thermoplastic memory. They're made to go to a certain point. Soon as you dilate a stent, you break it. You've broken its thermoplastic memory. You also risk bleeding, so I'm a little bit cautious.

**CLAUDIO DEANGELIS:** I think, if the patient is good from a clinical point of view-- three months, not before.

**MARK ELLRICHTMAN:** If the patient is clinically improved, then after approximately four weeks. And if the pancreatic fluid collection is almost vanished, then we remove the stent.

**CLAUDIO DEANGELIS:** For walled-off necrosis, it is the same. Because we control with our instrument endoscopically, which is the situation of the necrosis inside the cyst. So if we don't have complications or new symptoms, we don't use morphological imaging to see the cyst before two or three months. This is the protocol we used in the old days, in the last 20 years.

But I used to remove the metal stent, the [INAUDIBLE] stent. I used not to leave the metal stent longer than five, six weeks, because I don't want to have problem in the removal of the stent. So in that case, you could use CT or a EUS in order to define if the collection has resolved or not.

But it is not strictly necessary, because you can have a look when you go down with the endoscope. And you can decide that you can remove the metallic stent, and if there is still liquid or necrosis, or there is still the collection or some centimeters of collection, you can put one or two plastic stents inside and take away the metallic stent. This is my protocol.

I would prefer a forceps for foreign bodies, like a tooth mouth--

**SPEAKER 1:** Rat-toothed forceps?

**CLAUDIO**

Exactly.

**DEANGELIS:**

**SPEAKER 1:** OK.

**CLAUDIO**  
**DEANGELIS:** This is a problem of managing the patient with acute pancreatitis. It is today well-demonstrated that the patient should not be fed by [INAUDIBLE]. And you must provide the patient with parenteral feeding or internal feeding.

But today, the data that we have is that the interim nutrition with possibly with the catheter for a nutrition position after the Treitz ligament, because it has been demonstrated that this permits a good maintaining of the functionality of the gut. And there is nil stimulation of the pancreas.

Otherwise, if you put the enteral catheter in the stomach-- the nasogastric nutrition-- you can have more problems in the trial. We don't have so much data, but there are some trials that demonstrate that the nasogastric is inferior than the nasojejunal feeding. So we would prefer enteral nutrition with the nasojejunal catheter.

**NICHOLAS**  
**CARROLL:** Most of our patients will have nasojejunal feeding if they've been in hospital for a long time. We are a regional center. We often get patients who are sent to us very late in their disease course, which is a real problem for us. They may well have had very inadequate nutrition when they arrive. They often have hypoalbuminemia, so maybe they've even gone over to PN before we start.

Probably, the most favored route for nutrition would be the nasojejunal, but of course, when you're doing these procedures, that has to be removed and then replaced post-procedure. It lengthens the procedure and again, another reason for doing something under general anesthesia, rather than sedation. Having to go back and do a nasojejunal tube when you've finished a drainage procedure under conscious sedation is not very satisfactory. And so therefore, that's another excuse for using general anesthesia.

**CLAUDIO**  
**DEANGELIS:** The most the serious and threatening complication we can have in managing pancreatic fluid collection is the bleeding from vessels in the wall of the pancreatic fluid collection. And sometimes, this bleeding can be very catastrophic, and you cannot manage it endoscopically. You should manage it radiologically or even surgically. So this is the most important complication that can occur and mainly, when you perform a debridement and necrosectomy.



The other complications are the migration of the stent, the occlusion of the stent when you have too much debridement. So in that case, you should clear the stent with another endoscopic procedure or sometimes, you should substitute the stent. Perforation-- that is described. Pneumothorax, that has been described. But fortunately, we don't have such a complication until now, but they are described in literature.

**NICHOLAS  
CARROLL:**

I think you have to divide complications up into immediate, short, and long-term. In immediate-term, I think, if you've got a really solid necrosis, you might have difficulty deploying the stent. I think there's an increased risk of placement in a very solid collection. And naturally, you can get migration.

I, fortunately, have not had any significant migrations in my series that I've done, but I know that colleagues have. As I said, early migration is an issue. The other thing, of course, is bleeding. And if you decompress something which looks OK-- and of course, we're looking for evidence of vascularity with EUS before you deploy the stent-- but you have a compression effect if you have a sudden decompression, particularly when there's a lot of sepsis, and the pancreas has already been damaged maybe by chronic pancreatitis over the years.

There is a risk that you get decompression bleeding. And that's a short to medium-term problem. And then medium-term-- recurrent sepsis, recurrent bouts of infection. The other thing I've noticed is that sometimes the stent can cause abrasions in the stomach. It's not been the point where we've had any significant bleeding or any ulceration. But you notice, when you go down, that the AXIOS stent can cause some damage to the mucous of the other side. It's not been a major issue, and I don't know if other people have recorded that.

And then finally, obviously, when you're going down in the future for long-term sequelae, if you don't remove the stent, I'm concerned about stents getting buried by mucosal overgrowth or even internal migration as being another issue. So we traditionally have decided, through no particularly scientific method, that we feel we should remove the stent at six weeks.

However, also, I know people are leaving them for three months. And this is something that we'll have to see as time goes by. I suspect that there will be more problems with burying of stents if we leave them that long.

**MARK  
ELLRICHTMAN:**

When you puncture the gastrointestinal wall, you can create a perforation and a severe bleeding. The most common complication we experienced is a delayed bleeding after four to seven weeks, especially with the access AXIOS, that normally occurs from the contralateral side of the cavity.

We always try to do an endoscopic approach first and try to close the perforation with a clip or the [INAUDIBLE] clip. If that's not possible, then we transfer the patient to surgery in case of perforation. And the bleeding, we start as well with an endoscopic approach, injection of adrenaline, of fibrin or clipping. If this does not work, we transfer the patient to the interventional radiologist for coiling.

**COLIN MCKAY:**

Hi, I'm Colin McKay. I'm the clinical director of surgery in Glasgow Royal Infirmary in Scotland in the UK. I'm an associate professor at the University of Glasgow, and I'm in charge of the surgical oncology unit there. And I'm also responsible for endoscopy as part of my role.

Management of walled-off pancreatic necrosis has evolved considerably. I started off as a pancreatic surgeon back in the mid-1990s. And at that time, even the concept of walled-off of pancreatic necrosis wasn't fully appreciated, and the term itself was introduced in 2006. So it's that recent as a concept.

When we started back in the 1990s, patients with infected pancreatic necrosis would have major surgical debridement. They would have many days, many weeks often in hospital and in intensive care afterwards. And mortality, at least in our Royal Institution for patients with this condition, was somewhere between 35% and 40%. And that isn't unrepresentative of this condition across the world at that time.

In 1997, we introduced our percutaneous approach to patients with infected pancreatic necrosis, and we evolved a technique over some years that allowed us to upsize drains and manage these patients in a minimally-invasive way. And through that, we were able to show that our mortality came down to more like 20% from 35%. So we were convinced that this was the way forward.

It would be fair to say at that time, though, that many people thought that this was a procedure which was only suitable for certain selected patients. But again, over the years, we've shown that we could do this in almost all patients with infected pancreatic necrosis.

Now, at the same time, others were working on endoscopic drainage of similar collections. And like many units, we'd been draining predominantly fluid collections endoscopically for some time, with the more widespread use of endoscopic ultrasound. The role of endoscopic drainage evolved and expanded, so we started draining more complex collections endoscopically once we were able to do this under EUS guidance.

The real shift, though, I think, particularly in my experience, was that we started doing patients who had true infected pancreatic necrosis, patients who were sick, often, patients who were critically unwell. We started to use endoscopic approaches to drain these collections towards the mid part of the 2000s. And nowadays, this is our preferred approach.

We still use percutaneous drainage. We still use the minimally-invasive retroperitoneal approach for collections. But our preferred approach is endoscopic drainage. I think the real challenge that we now have is trying to work out which of the very many approaches that we have is the right one for the right patient. But what I think we can now say with some certainty is that the days of open pancreatic necrosectomy for necrotic collections in infective pancreatic necrosis these days should be over.

One of the big challenges we have as clinicians looking after these patients now is whether we should approach them with a surgical approach or an endoscopic approach when we decide that intervention is required. And obviously, there are many patients where an intervention isn't required.

But when we talk about surgical intervention, what we really mean, though, is a primary percutaneous drain followed by upsizing of that drain or a necrosectomy through a minimally-invasive retroperitoneal approach, a so-called VARDs approach. So when we talk about surgery, it's important to recognize we're not talking about conventional, open pancreatic necrosectomy, which is an operation and, hopefully, confined to history.

Now when we see a patient who would be suitable for both approaches, I think, at the moment, we have no evidence of which is the best. We heard today, presented from the Dutch pancreatitis study group, the results of the tension study comparing endoscopic against the percutaneous and surgical approach for infective pancreatic necrosis. And they found no statistically significant difference between those two approaches, which, I think, would marry with the experience of many of us who have experience of both ways of managing patients.

At this moment in time, the choice of procedure will depend very much, firstly, on the position of the collection, the expertise available and the logistics of access to endoscopic ultrasound and to endoscopy. There are sometimes patient-related factors and the anatomical location of collateral vessels and other factors that you can bring to bear.

And what we do is we discuss all these patients in a multidisciplinary meeting. So we will sit down as a group, and we will often argue and discuss at some length what is the most appropriate way forward. And that I think, at the moment, is what we have to do. We have to manage these patients in a multidisciplinary environment and bear in mind that there's many more ways than one to manage these complex problems.

It's very important that the multidisciplinary management of patients isn't confined to the initial discussion of how best to approach the collection for the first intervention. Many of these patients require multiple interventions. And many of these patients will require more than one approach.

So for example, in the tension study just presented, 30% of patients initially managed by an endoscopy approach had to have a percutaneous or surgical approach at a later date. And again, that's very much in keeping with our own experience. And likewise, there our patients who are initially managed percutaneously who subsequently go into an endoscopic intervention, often to internalize a persistent pancreatic fistula. So we need often a variety of approaches in any one patient.

In fact, some of the most complex and difficult patients are the ones who have extensive, diffuse retroperitoneal collections, which very often require not just one, but two percutaneous drains and an endoscopic approach as well.

We've been looking after patients with pancreatic collections managed in a minimally-invasive way now for almost 20 years. And there is no doubt that the clinical outcomes of minimally-invasive management, however we do that, are significantly better than they were in the days of open pancreatic necrosectomy.

Now the big difference between patients managed endoscopically compared to patients managed by percutaneous initial approach is the reduction in pancreatic fistula. If you manage patients with a percutaneous drainage, followed by a retroperitoneal debridement or percutaneous necrosectomy, almost inevitably, you will have a pancreatic fistula. And sometimes, these can be a persistent problem.

If we can avoid that, I think that's desirable. And we don't see that with endoscopic drainage. The bigger challenge endoscopically is the management of the necrosectomy, which is still a challenging and time-consuming procedure. But ultimately, the clinical outcomes are the same.

The idea of an all-in-one approach to pancreatic necrosis is how I was initially trained in managing these conditions. And the mortality of these procedures when you use an all-in-one approach to sick patients is very high. What we evolved over many years is exactly the opposite of that. It's trying to do a little at a time through multiple procedures. And that's how we managed to bring down mortality from this condition.

Now it is true that if you deal with patients who are very late in the evolution of their pancreatitis-- so once you get out to two or three months after the initial presentation-- then it is possible at that time to do an all-in-one procedure, where you deal with the collection, and you deal with the necrosis. And the example that we would now use for that would be a laparoscopic cystgastrostomy.

So where you've got a collection which would be suitable for transgastric [INAUDIBLE] by a laparoscopic approach, then I think there is, at the moment, a degree of discussion around whether it's better to do an endoscopic drainage and have to take the patient back for two or three endoscopic necrosectomies or one laparoscopic approach, where you can deal with necrosis in one sitting. Now we don't know the answer to that. So at the moment, we are entering these patients into a randomized trial. And within the US, there's another randomized trial very similarly, a good one at the moment.

So we don't know the answer to that. And certainly, the technical challenges of a laparoscopic cystgastrostomy are significantly greater than the technical challenges of placing an endoscopic transgastric stent. The total hospital stay, however, may be higher if patients have to come back for repeated endoscopic procedures. But as I say, at the moment, I think we do not have good evidence to guide that. And I think we need to wait until the two randomized trials that are ongoing are completed.

I believe the key to managing these patients successfully is to have an effective multidisciplinary group. In our own institution, we are very fortunate, because the surgeons are also the endoscopists, so we think of ourselves as our own multidisciplinary group. But if you are going to be working with these patients, it's important that you trust each other, that you're able to rely on each other's technical abilities and judgment.

Things do go wrong when you're carrying out these procedures. So if you're an endoscopist, you definitely need to have surgeons who are supportive, who are prepared to help you out sometimes in an emergency and to prepare to sometimes pick up the pieces when things go wrong. The advantage to patients, if we can work together like this, is that we can use a whole variety of minimally-invasive techniques and, as I said before, and often multiple different techniques in the same patients to get a successful result.

And we also mustn't forget the role of intensive care physicians and other physicians as well. One of the things that we found very important over the years was that intensive care physicians started to believe that these patients who were often very, very unwell could recover from their illness with repeated protracted interventions, often over many months.

The hospital costs of looking after these patients can sometimes be very high. And certainly, in the days of open pancreatic necrosectomy, we struggled to persuade intensivists that it was often worthwhile carrying on with patients in the face of what seemed to be irretrievable multiple organ failure. But nowadays, we'll get most of these patients through, and the intensive care physicians believe that that's the case.

Well, the step-up approach was first described by the Dutch pancreatitis study group. But it really refers to the approach to pancreatitis that [INAUDIBLE] group evolved in the 1990s, which is to do a little and to do it often. So you start off with percutaneous drainage, and you then upsize with those drains, and then you do necrosectomy slowly and repeatedly over the course of a few weeks.

And what we discovered when we started out on this journey was that the more we did at early stage in the illness, the more we risked worsening multiple organ failure or causing multiple organ failure. So it was through trial and error that we discovered that the patients would do better if we did a little bit in the first procedure. So just drain it in the first procedure, and then defer the formal necrosectomy until the patients have recovered from their organ failure.

And the Dutch pancreatic study group were able to prove in a randomized trial that this was associated with a reduction in morbidity. So this is an evidence-based approach. We know it's a way to manage this condition. The big question we now have is whether endoscopic or percutaneous approaches for initial drainage are the best way forward. And the tension study presented at UEGW this week would suggest that you can choose either, that the results of both are broadly similar. And perhaps, what we need to be looking at now is, what is the right procedure in the right patient?

Our aim in managing patients with pancreatic collections is, firstly, to do no harm. So many patients with late pancreatic collections are clinically-- well is perhaps the wrong word. Maybe they're struggling to eat. Maybe they have postprandial discomfort. Maybe they've been losing weight.

But they're often not septic. They're often ambulant. They're often in the community. And so when we're doing an intervention for these patients, we have to be very careful that we're not causing them harm. And the great beauty of endoscopic versus any kind of percutaneous or retroperitoneal surgical approach to these patients is that they don't have drains in their side. They don't have fistulae that can linger for many weeks.

For patients who are sick, for patients in the more acute phase of the illness, our aim is to get these patients out of hospital alive. And in this situation, our primary aim is to do what we think is the right thing to deal with sepsis, to deal with sometimes very complex collection. And this is really where we're talking about using multiple different approaches.

Studies on the quality of life of patients recovered from intervention for pancreatic disease are few and far between. And we're often looking at very different patients who recover now from the most severe forms of infective pancreatic necrosis are really quite difficult group of patients to manage over many years.

Many of these patients in the past didn't survive. And it's been a learning experience for us to see how three and four years after recovery, patients can still have problems with their psychological approach, with their physical recovery. And there's a lot problems that these patients have.

I think, far more important, though, is that they're now surviving. It's the minimally-invasive approaches and the step-up approach, in particular, that's made that difference.

The two options that we have when we're faced with a patient who's got infected pancreatic necrosis are endoscopic or percutaneous drainage as the initial part of a step-up approach to managing their sepsis. The advantage of endoscopic drainage is that we are able, in very simple, straightforward procedure, to place a relatively wide bore drain under EUS guidance. So with the new self-expanding metal stents, we can place 15 millimeter stents in these collections. And in real time, we can see complete decompression of these collections, with the fluid component emptying into the stomach in front of us.

Percutaneous drainage requires input from interventional radiology. So again, it is not within our control, which again, as part of a multidisciplinary team, shouldn't be a problem, but sometimes can be, depending on local expertise. But the drains that are put in are much smaller, and they're also longer. And so the ability of these to drain the thick purulent, often semi-solid collection is a problem, and it has been a problem for us for many years.

And for that reason, we very commonly had to take patients under general anesthetic to the operating theater to upsize these drains within 48 or 72 hours of the initial drainage because of no improvement in septic parameters. So I think the ability to place a large bore drain in one sitting endoscopically is a definite advantage. The other advantage is the reduction in pancreatic fistula formation. Clearly, it's almost universal after percutaneous drainage. But it's much less likely after endoscopic drainage.

The disadvantage of endoscopic drainage is the ability to go into the next stage of the step-up approach. In other words, the necrosectomy. Most people, I think, would accept that the endoscopic necrosectomy component of this procedure is still a challenge. The instruments that we have to do that are not ideal. We often spend a lot of time taking small amounts of necrotic tissue piecemeal from these collections.

Certainly, both percutaneous necrosectomy and the VARDs approach-- the Video-Assisted Retroperitoneal Debridement-- allow you to remove much larger quantities of necrosis, even complete pancreatic necrosectomy, in one sitting. So I think, with improvement in the approach to endoscopic necrosectomy, that's really what will drive the future development of this approach.

For surgical drainage of walled-off pancreatic necrosis and a one-stop procedure, what we would now be talking about is a laparoscopic transgastric necrosectomy. Now that is not always a straightforward procedure. Patients with splenic vein thrombosis and multiple venous collaterals can present a challenge, from a bleeding perspective.

The peritoneal cavity after acute pancreatitis is often a hostile place, with evidence of peritoneal fat necrosis. And although it may look attractive on CT, sometimes the intraabdominal findings are much less attractive to laparoscopic surgery.

And you have to make sure, of course, that you're doing this on the right patient at the right time. If you try and intervene too early, you can find yourself doing a surgical procedure, but with very adherent and difficult necrotic tissue that can't all be removed in one sitting. Or if you try and remove it, you can cause sometimes very challenging bleeding. So you have to make sure that you leave it long enough that all of the necrotic tissue has separated from the underlying viable pancreas. And that's what it allows you to do that safely.

So with a very late collection in the appropriate patient, I think there is still a case for doing this in one procedure laparoscopically if you have the relevant skills. But it's not something that is suitable for all patients. And the earlier you are in the condition, the less appropriate a one-stop procedure, however you want to do it, is. And certainly, for patients who have infected pancreatic necrosis who are unwell, we know that doing this as one procedure is the wrong thing to do.

I've been arguing the case for minimally-invasive pancreatic necrosectomy for 20 years. And the people I was arguing that with were predominantly surgeons. And when I first presented on percutaneous necrosectomy back in, I think, 1998 or thereabouts, the argument that was put forward was that this was a very highly-selected group of patients and that these were patients who weren't really representative of the whole spectrum of infected pancreatic necrosis, which was what we were dealing with then.

But over years, this has now been adopted across the world by many institutions and has now been proven to reduce morbidity in a randomized trial. So surgeons approached infected pancreatic necrosis with the idea that one big operation was the answer until it was shown to them that this was not appropriate and that this was causing patients harm.

We know that minimally-invasive approaches are the way forward for infected pancreatic necrosis. The question is, which one of the minimally-invasive approaches should be used? And at the moment, that depends on local expertise and patient-related factors.

For patients with late pancreatic collections-- what we used to call, back in the 1990s, pancreatic pseudocysts, but now called walled off pancreatic necrosis-- again, a patient-directed approach is necessary because these are not all the same. If you have a patient who has a predominantly necrotic collection with very little fluid component, I would argue that some of these patients who struggle with an endoscopic drainage approach, it's often very difficult to get adequate drainage. And maybe they're the ones that are best managed by a laparoscopic transgastric approach.

Whereas the fluid-predominant ones, we can drain those very easily, often without the need for further interventions in the majority of patients in a procedure that can take one minute or so. So I think it's not really about which is better. It's which is better in the appropriate patient.

The real question that should be asked now is not whether minimally-invasive surgery is the best way forward for patients with pancreatic collections, but which of the minimally-invasive approaches is appropriate? And because of the heterogeneity of the patient population that we're talking about, we're talking about patients who can be anything from a critically ill 35-year-old in intensive care with an infected pancreatic necrosis right up to a patient who is three months or four months after the attack of pancreatitis with a walled off collection, who is clinically well, but with some postprandial discomfort.

And how we manage these two patients may be very different. So the important thing is that we have a range of minimally-invasive approaches. The important thing is that we have a multidisciplinary team who can help decide the appropriate intervention in the appropriate patient in the absence of good evidence either way. But most important principle is that, in this condition, less really is more.

I'm often asked what my strategy is for managing patients after initial drainage. And of course, it very much depends on the individual patient. There are one or two things that I think I would say of my own experience. First of all, if a patient is clinically septic, if a patient has any evidence of systemic organ failure or is clinically septic, then I would place a nasocystic catheter for lavage after the procedure. And primarily, that's to just make sure that the stent remains patent in the 24, 48 hours after the initial drainage.

I have had patients who've become extremely unwell in the first 24 hours and gone back to find that the stent had blocked very quickly with loose necrotic debris. So in sick patients, I think, post-procedural lavage is an important component of it. In patients who have extensive necrosis after drainage, I will leave-- [AUDIO OUT] I think that helps to stop ball-valving--

[INTERPOSING VOICES]

**MARK** --in the stent itself. So that's something that we do routinely now in patients with extensive necrosis. For patients  
**ELLRICHTMAN:** who've got fluid predominant cysts, where we can visualize under EUS this is collapsing to near normality, as we do the procedure, then I wouldn't place any further stents. And I would allow that patient home within 24 hours. I would arrange a CT, usually at three weeks, and then we bring the patient back at four weeks or five weeks to take the stent. And that's often all we need to do for that group of patients.

So obviously, there's a spectrum. For patients who have necrosis who we anticipate that we will need to do further procedures, then what we now do is we bring them back weekly until we're satisfied that the collection is resolving or resolved. So that can often be three four, sometimes five or six procedures.

We would guide the time to stop by a CT scan evidence of resolution. But what we find is that if we leave patients in the community for two or three weeks who've got extensive necrosis, we have patients being readmitted into district hospitals, which can present problems.

So what we're trying to do is to bring patients back into routine care proactively on a weekly basis. And often, all we need to do is wash out the collection with a lavage component of a heater probe, just a vigorous lavage, clean it out, make sure that the stent is patent, and then allow them home. And we could do that on an outpatient basis.

There's a now insignificant number of patients with pancreatic collections who have splenic vein thrombosis and associated left-sided portal hypertension with gastric varices. And these are patients where transgastric drainage under EUS guidance is very safe, but there are one or two concerns.

One can be if the collection is very large, then sometimes, the vessels, particularly venous collaterals, can be compressed by the cyst. And although, even with the addition of Doppler, you can think that you're going through a safe part of the gastric wall, when the cyst decompresses, you can get massive bleeding from a gastric varice. It's rare, but it does happen.

And the other problem that we run into with these patients, on occasion, is if the stent becomes embedded within the gastric wall. And then when you go to take the stent out, you can get very major bleeding if you've got gastric varices. So it's something to be cautious about. It's something to bear in mind when managing patients who are known to have splenic vein thrombosis.