CAROL E. SEMRAD: So I'm going to talk to you about advances in small bowel endoscopy. And the first thing I think everyone understands here is the small bowel is very long. It's anywhere from 360 to 800 centimeters in the adult. And therefore, there's been difficulty in accessing the bowel and a delay in technology in this area.

But why do we need to access it anyway? The small bowel is quite hardy. You don't really get the kinds of cancers you get in the stomach and the colon. But you do develop bleeding in the small bowel from various lesions. Obstruction due to a stenosis or a tumor.

And then there is incidental abnormal imaging findings sometimes people stumble upon in foreign body removal and, actually, direct J-tube placement. So there are reasons to get into the bowel.

So really I'm going to talk about these new technologies to examine the small bowel that have really revolutionized small bowel diagnosis and management, in the true terms. And the first was this new disruptive technology, the wireless capsule, brought out in 1998. And really, it's a camera that naturally passes through the intestine.

And there are two models now out on the market. And they both work by radiofrequency. There's another one out just recently that works by body field propagation.

But clearly, we have with the capsule a better way to see lesions. But we weren't allowed to treat. And that's key. So we needed to develop tubes and devices to get into the bowel and deliver therapy.

And Dr. Yamamoto in Japan was the first to develop the double balloon enteroscope, which has as its feature a balloon at the tip of the enteroscope and on the overtube. And we'll go over the mechanism in a minute.

The single balloon has just a balloon on the overtube and is also latex free. So that's good for that reason. And the spiral is a different technology, with the spiral element on the end of the overtube that allows you to use rotational energy to get through the bowel.

But our radiology colleagues are right on the heels of small bowel diagnosis and therapy because they now have developed, or developed over time, the multiphase CT enterography in which they give contrast collective venous in an arterials phase and then neutral contrast to fill up the lumen of the bowel.

And this is now very sensitive in picking up small bowel tumors and, in particular, wall lesions like inflammatory bowel disease. Not so good yet with vascular lesions. We don't know what the impact of this technology will be. But certainly they can pick up to five-millimeter-size small bowel lesions, as shown in the left panel.

Now what about the video capsule? So it's highly sensitive in allowing direct and noninvasive visualization of the small bowel mucosa. Remember, there's a wall to the small bowel. So we can't just say if the mucosa shows no lesion that there's no disease.

That said, for flat lesions it's clearly the top device to detect disease. There's a high diagnostic yield in patients with obscure bleeding and in refractory celiac disease. But very low in patients who present with diarrhea and abdominal pain without other signs and symptoms. So it's really not good for that. And it's well accepted by patients.

And here you can see what we call definitive lesions in the top bar and ulcerating stenosis. The second is angioectasia. Third is a submucosal mass lesion. And the last is a hemangioma seen in blue rubber bleb nevus syndrome.

Now what about the limitations of capsule? Well, the biggest limitation is you can't sample or treat. But in my world, equivocal findings are equally vexing. And that means that at the top-- This was sent to me called a polyp. But really you can see, if you look closely, an air bubble that refracts light differently. There's debris under the air bubble. And so that really was just an artifact.

The middle, you can see some small red speckles at the bottom of the mucosa in the middle screen. And that people called angioectasia or AVM. But it's unclear whether these red spots have any clinical significance.

The bottom was called an ulcer, and that's the lens pressed up against the mucosa in a compressed lumen. So you need to be careful in reading these.

What's new? There's improved optics, lenses. The capture rate is increased to get better imaging. There's now this mosaic image viewing in which you can stack up images frame by frame on one screen and compare frame to frame, which helps with reading.

There's an increased field of view to help detect lesions. And there's a new sensor belt. But you have to be careful in obese patients greater than 30 BMI because it drops images in the very obese. And then there's the 12-hour capsule, which is very useful in lessening incomplete studies, which is about 20% with the eight-hour capsule.

Now what about the summary for the capsule? It's safe in children greater than two years old. This is now approved for children. Before it was still questionable at what age we could start placing them in children. And it's likely safe with pacemakers and ICDs.

But the FDA will not approve it and probably will never approve it because there are so many new devices and different devices. And not all have been tested to see whether the capsule could interfere with the pacemaker. That, of course, is the biggest fear.

CT and MR enterography and patency capsule do help predict the risk for capsule retention, especially in Crohn's disease and those who present with obstructive symptoms. And really the small bowel follow through the barium study does not predict capsule retention at all so should not be a security factor in proceeding with the capsule in a high-risk patient.

You really need one of the enterography studies to look at the wall thickness. Because the capsule's not pliable. Barium's very thin and can get through anything. Almost.

Now let's go to device-assisted deep enteroscopy. Here there's been a total shift in treatment of small bowel bleeding from surgical to endoscopic management. And here I put a person on a surfboard because here you can control it versus the capsule that tumbles out of control through the intestine.

There's two ways to do it, as I talked about earlier. There's the push and pull technique on the left and middle, with either the double or the single balloon technology. And that really banks on the endoscope advancing on the left into the small bowel. Then the overtube comes forward.

In the second image, you can see the two balloons up in the cartoon pleating the bowel back. And then, of course, the balloon scope goes down. And you go through segment by segment.

On the right is the rotational way in which there's a corkscrew device on the tip of the enteroscope that, when you rotate the overtube in a clockwise manner, the bowel pleats on the back of the overtube.

And then to compare enteroscopy devices, people always say, what's the best? Is it double? Is it single? Is it spiral?

Well, the diagnostic yields are really similar. And in small studies, what comes as a sort of global summary, the double balloon you can get the deepest in the small bowel. The single is easiest to set up and maybe use if you're not an experienced enteroscopist. And the spiral is the fastest in a nondiagnostic test. But if you have to perform therapy, it takes about as much time by the spiral technique as a single or double.

And the complications are similar. Perforation, pancreatitis. And virtually all get deeper than push enteroscopy. Now in terms of imaging modalities, just to compare.

If you look at intraop enteroscopy there, clearly the yield is highest. It's an internal-external examination. Capsule and deep enteroscopy are next up to 80%. And you can see the push enteroscopy, CT, enteroclysis, or even enterography without triple phase, and small bowel barium are much lower for bleeding lesions.

And in terms of device enteroscopy limitations, it's really, again, time consuming. There are incomplete studies due to either fixed bowel, long bowel, short mesenteric stalk, or altered anatomy. The working channel is small in the enteroscope right now, making it difficult to pass tools.

And it's hard to position lesions when you have a two-meter scope and you're trying to control the tip when you're super coiled in the abdominal cavity. But despite it all, we can pretty much do everything in terms of therapeutics, thermal therapy, polypectomy, putting in a PEJ, a direct jejunostomy, and even stenting, although that's a little more challenging.

And here I'm going to just show you a few videos about the treatment. Here is an example of treating polyps, which are mainly hamartomas in the small bowel. And the key point is you have to find the stalk. These are big polyps.

You need a hexagonal big snare. And if the stalk is large, you might want to inject with ink to be able to keep track of it visually. And maybe to prevent bleeding after you've performed polypectomy.

So if you start the bottom video. This is a young man with Peutz-Jeghers polyposis and obstructive-type symptoms. I marked with an ink mark where the polyp is. In case something goes wrong, the surgeon will know where I was.

And here is the snare. It's kind of scary. It's blind. You're going around a big polyp head. And finally you get to the stalk, which is right there. And you transect.

And that's really the goal of taking out the big polyps. If you do it piecemeal, there's a 3% risk of bleeding. So it's better to get down to the stalk. They tend to be quite bland in terms of bleeding. Next.

And then, of course, there are still things we can't do in the small bowel. And that is submucosal lesions and ulcers. If they bleed, we really have little recourse to treat other than to resect them. So here lesion marking becomes important.

And if you start this top video there, this is the video of a submucosal mass lesion. This is a carcinoid in the distal small bowel. It's ulcerated. So the first step is to biopsy, if you can, at an ulcerated site so you can get a diagnosis, help the surgeon. And then you mark in a distal position. And if you can, in a proximal position. Two tattoos are good, especially when they are well placed.

And stop that video. And the bottom video is, go back, please. The bottom video is Dr. Prashant, who is one of the surgeons who performs laparoscopic small bowel surgery. And here he's going after the same lesion to remove it.

And here you can see the challenge of just getting to the bowel. The surgeon is pulling it out and untangling it. But when you try to do it endoscopically, it's not so easy.

But this points out the surgeon finding the tattoos. You have to be accurate. And how difficult it is laparoscopically for them to see that lesion. It looks big to us endoscopically. But not always obvious from the external point of view.

And then the surgeon can internally resect it. And then go on and remove it. And here is the lesion out of the body with the tattoos flanking it. Next slide.

And we can dilate strictures. Here's an example of balloon dilation of a lesion. It's a short, the favorable ones are short segment, fibrotic, and NSAID related. You can see the balloon catheter going across. I usually dilate to 12 millimeter. And there you can see on the right the open lumen and the somewhat dilated bowel on the other side.

In terms of mid small bowel bleeding, the most common is AVMs. And so 60% of our bleeders are going to be due to AVMs or angioectasias. This is most common in the elderly. It's the most common finding on capsule. And it occurs mostly in the upper small bowel and colon.

And basically the risk factors are aortic stenosis, renal failure, and these left ventricular assist devices, which are very problematic. 15% to 40% of these patients bleed.

Most of these are small bowel bleeders. Rebleeding is common. And it's the flow. The fact that they get acquired von Willebrand factor and that they require anticoagulation.

And here's an example of why it's important to characterize these lesions endoscopically because you're going to choose a different therapy. On the left is a typical venous angioectasia. And here you're going to, if it's not bleeding, use APC therapy, which is very effective.

On the right is arterial lesions and AVM with a dilated vein and a polypoid center, which is the arterial part. A raised lesion on the right. And sometimes you see streaming blood and/or pulsating blood. So if you start the video at the bottom.

So here I came upon deep, actually, in an LVAD bleeder in the small bowel. And pretty deep here, I see red blood. I wash. And there's the streaming vessel.

And because I was so super coiled deeper in the bowel, I couldn't get the BiCap probe out. So I had to flush it with some epinephrine to try to slow it. Then I used the APC probe.

But really when you see one of these pulsatile lesions, getting a clip out is probably the most effective. And even if you burn, put two clips on if you're deep in the bowel so you don't have to go back.

So who's going to rebleed? This is a problem with angioectasias, which is 60% of our small bowel bleeders. Well, the people who have vascular lesions, as shown in the left, 40% of them rebleed.

But if you look on the right and these authors analyze comorbidities, you can see that what really correlates with rebleeding is comorbidities, mainly renal failure and portal hypertension. And it's unrelated to the NSAID or warfarin use. So really it's the people who are sick that rebleed. Next.

So what do we need with-- I've just got two more slides. We need in terms of advancing deep enteroscopy, there's a motorized spiral device being worked on. So that may help us drive in and out of the small bowel. The double balloon enteroscope is coming out with a larger channel, which improves your tool passage. There are some new tools, not a lot.

But what we really need is some prospective randomized studies to look at therapy of these angioectasias. Is endoscopic therapy better than medical therapy? Who do we choose? When is it going to be effective?

Medical therapy now with octreotide, thalidomide, and the antivascular endothelial growth factor antibodies are quite effective. Hormone therapy is passe and ineffective.

So in summary, small bowel endoscopy is here to stay. In 10 years it has really revolutionized the diagnosis and management of disease, in particular, bleeding, Peutz-Jeghers polyposis, and really picking up and acting on small bowel tumors.

The technology is only going to improve. And I really predict it's going to go into standard GI endoscopy. There's no reason why it has to be in an advanced endoscopist's hand. I think all trained endoscopists can do this as soon as we get a little better with the technology and maybe with the reimbursement. And with that I will end.