

Surgical Staplers: Joseph Bennett, MD

Intro

I'm Dr. Joseph Bennett, and I'm the Chief of Surgical Oncology and most of my responsibilities are clinical, which revolve around caring for cancer patients and doing surgical evaluations and also helping run the Division of Surgical Oncology. And also integrating within our cancer center to support our multi-disciplinary teams for liver and pancreatic cancer and also for melanoma, sarcoma, and stomach cancer.

Why do you use a surgical stapler?

I use surgical staplers probably in almost every abdominal case that I do. It's the best way to get a seal on blood vessels and also on any solid organ, and also in order to connect different organs. So one perfect example would be like yesterday I did a pancreatic resection and we had to transect to the pancreas and you have to seal the ducts in order to prevent the pancreas from leaking. So I used a surgical stapler for that. But we also have to remove the blood vessels that are going in and out of the pancreas. And without a reliable way of sealing and cutting, patients will end up with significant bleeding. Granted, we can sometimes tie or clip, but it's not always as easy to get into very small, tight spaces. And the staplers allow us to get into tight spaces and to fire the stapler and both cut and seal at the same time. And then when it comes to intestinal surgery, a lot of times we have to remove part of the intestine, but to restore the continuity either in the large or small bowel or the colon, or in the stomach. We have to not only cut out, but to reconnect. And the surgical stapler allows us to reconnect, but also create an open lumen for the intestinal tract so food and intestinal contents can get through. So it's a majority of the procedures that I do.

What defines the success of a surgical stapler?

The success of the stapler, I think is twofold. Number one, it's hemostasis, which is controlling bleeding. It's very frustrating when we fire a stapler and then the tissue is bleeding- when the goal of firing the stapler was to seal a blood vessel. So there are stapling devices that have not done that very well and we've switched from those. And the last thing you want to have to do after stapling is then reinforce the staple line. So vascular control is very important to stapler function and also just the seal between the intestinal tract or any solid organ. You don't want it to pop open and leak the integrity of the staple line, whether it's a solid organ or it's a tissue with a lumen or it's a blood vessel is probably the most important factor in the success of a stapler. Anytime we staple, if it blows open, that's bad.

What challenges do tissue or anatomy present when stapling?

Well, when tissue is very thick and we do get into this situation where very hard or fibrotic, it is sometimes very hard, at least in my world, to staple through something. And a perfect example would be, let's say a pancreatic cancer. Granted, I'm not stapling through the cancer but the pancreas after chemotherapy, pancreatitis, inflammation, response to chemotherapy could get very thick and fibrotic. Maybe the patient has pancreatitis. They have calcifications within their pancreas. Even if I use the biggest stapler, it is sometimes very hard. And I've had it where the stapler could not go through the tissue. So there are limitations in that regard. Also, whenever there's inflammation, infection, or the tissue is friable, you try and staple something- that tissue is not really amenable to the staple line and it can break down. And there are times when you staple, and you realize that staple line is not going to hold, this tissue is just going to fall apart, and you have to reinforce your staple line with a suture. There are other times where there's just mechanical failure. And for whatever reason, the stapler just doesn't fire properly. And that could be a potentially life-threatening situation. If you're stapling a major blood vessel, you're in a tight spot and that stapler doesn't fire well, and there's massive bleeding when you take that stapler off-- That is tough because you're using the stapler because you think that's the best device and the tissue may

have, it may not be amenable at that point to suturing or clipping. So those are probably the most common situations where we have real trouble.

How do you know when a problem has occurred?

So we know about problems with the stapler in abdominal surgery anywhere from a few seconds after firing it till five days. And the reason why is because if it doesn't seal the blood vessel, then you see it right away. And with that said, there are times that somebody, and I don't say this facetiously, can cough, their blood pressure can go up-- this could happen post-operatively and they bust open a staple line, let's say a day later. And they can bleed. For intestinal problems, you may not know that an intestinal, we call it an intestinal anastomosis, when you hook two parts of the bowel together, you may not know that it's not taking until four or five days later when it starts leaking and the patient gets a really sick. And I can think of one case in general, where five days later, I did have to take somebody back to the operating room. There was a small area in-between two staple lines where it just didn't hold and it busted open. And it was a pinpoint hole, but that's all you need for intestinal juices to fill an abdomen with liters of digestive juices. And the patient was very critically ill. So sometimes you just don't know. It's unfortunate.

What is the process of setting up a stapler?

To set up the stapler, there is the mechanical device and it has a protective sterile coating that comes with it and that is the part that is disposable. So the stapler itself with all the mechanics is obviously expensive. You don't want to throw it out each time. So there's a sterile protective case that comes with it. And that first goes on to the surgical field. And then with the assistance of the circulating nurse and the scrub tech, they put the system together and then the individual shafts each come in its own package. And depending on what the surgeon needs, we open up the shaft with or with the stapler, and then attach that shaft to the actual handpiece device. The handpiece device has a little extension on it, which connects to the shaft and then it just clicks in place. Again, sometimes there's a learning curve and people don't know how to click it on and off. And you would imagine this would be intuitive, but the stapler has to be just in the right position, has to be like Goldilocks, perfect before you can get the stapler on and off- and in particular, off. It's easier to get on. But after we turn it and move it, if it's not like completely lined up, then it can be difficult to line up and take off. But the setup, again, it's not that complicated for the people who know how to use it. For people who haven't learned how to use it- and again, we do surgery at all times of the day and night- it can be frustrating.

How often do you use a surgical stapler during a surgery?

During any particular operation, sometimes the use of staplers can vary from just two or three loads. And each time we fire it gets its own load. So just to clarify, on the way the mechanism is designed, there's a handpiece and then the stapler itself is on a shaft that gets attached to the main handpiece. And so the handpiece stays the same. But the stapler, which is attached to the shaft is removable, it comes off and we put it back on. So if I'm not going to use the stapler more than 2-3 times then I may not open the stapler because it is a expensive device. So I likely would not open it for just one use. So at least two or three or four critical. If I'm going to use it once or twice, it would have to be critical, in other words. But some operations, I'll use it 15, 20 times. But if I'm doing a big pancreatic resection, definitely would 12, 15 different loads. Some of our cases, like a liver resection, we can easily go through 10, 15, 20 loads as well. Not only to cut through liver tissue, but all the blood vessels, bile ducts, anything that we need.

What factors can impact the success of a surgical stapler?

Well choosing the right stapler. Number 1, it's the inherent mechanics of the stapler itself. But skipping ahead to what I just said, it's also the load. So the surgeons are responsible for choosing what size stapler we want. So there's a vascular load and those staples are a little bit tighter. They're closer together and they are also a tighter squeeze. And then when we're using a bigger stapler, like what we would call a

green load, that would be for a thicker organ. So if you just think about the size of a blood vessel, intuitively, it's a lot smaller than the size of the stomach. The stomach, it needs a much bigger load. If you try and use a stapler for the stomach on a blood vessel, it's going to be a loose seal and it will bleed. If you try and use a very small stapler like for a blood vessel on the stomach or you choose unwisely, then it will burst open because its very small staples can't go through a thicker organ. So some of it is surgeon's choice. With that said, the newer devices and what we're using right now actually above and beyond surgeon's choice because it may sound easy, but there are times when it's not as easy as you would think to choose between one stapler and the other. Maybe you're on the cusp between a vascular load and an intestine the load and maybe a thicker load. The current stapler devices actually have multiple different layers of staples of different thicknesses. And they also measure the pressure with the software that's within the stapler head and they measure the actual pressure of the tissue. So if I tried to put a vascular load on a stomach, thick tissue, it wouldn't let me fire. And it has a number on it, 1, 2, or 3. And if you're up at three, you may want to consider going up to a higher load. So the current staplers are actually measuring the thickness of the tissue. And that's seen not only in the laparoscopic and open, but also in the da Vinci robotic staplers. They also are integrated with that pressure measuring system. And so that's extremely important. Not only is it our judgment, but you now have actual software measuring tissue compression, which helps us make that decision and sort of is like an extra safeguard, like a belt and suspenders type approach.

Compare older and current staplers.

When I first started using staplers compared to what we use now, they were sort of primitive. They were two mechanical ends. You would decide what load you want. Either a vascular, which we call a white load or blue load, which is in-between. And then the green load is thicker. And you would put two ends together and you would fire the stapler mechanically. It doesn't have significant reach. So it was a little bit limited, and it's a bulky instrument. The instruments now become a little bit longer, a little bit more thinned out. They measure the pressure like I said, and they also have more layers. So the staplers are not just two layers, there's three layers and the staples sort of go down and up and down again, almost like a W or an M, but they curl back up again. So we look for even how the stapler fires the staple itself like the individual stapler.

What is visual and physical access like during surgery?

Access is one of the most important things as surgery, setting up the case and visualization. With that said, with certain anatomy-- let's say there's a large tumor. The patient's anatomy is unfavorable. You're operating deep in the pelvis or high up in the esophagus, access can be an issue. So the staplers that we use, they have a long shaft to them. There are staplers that are even longer meant for laparoscopic cases, meaning the minimally invasive cases where you're going through the abdominal wall through a trocar, which is like a sheath. And those staplers have to be longer because you have to go through the abdominal wall. But even for the open cases, the staplers with the shaft allow you to get into very tight spaces where you cannot get a bulky stapler and your hands and fire the mechanism within the deep pelvis or high up in like the upper abdominal quadrants.

Powered vs. non-powered staplers

So I use non-powered staplers very infrequently. It would have to be, for example, if I'm doing an appendectomy, I prefer to staple across the base of the appendix and it would just be one quick fire of a stapler. So I don't need to open up the powered system because it's a bit more bulky, bit more expensive. There's really not a benefit to using it. So I would use a non-powered stapler right now very infrequently, but only when I need one or two simple stapler loads. I've converted to almost to using almost powered staplers for every single time I need to use a stapler in particular because it's just better quality, better seal, more reliable. I like the fact that it measures the burst pressure. I liked the design of the stapler. Also, it's

less chunky. The way that the staplers used to be without having this particular design is just harder to use, harder to get into tight spaces.

What are some frustrations when using surgical staplers?

Well no stapler is perfect. The staple system that we use now I think is the best that's been out in a very long time. It is bulky for people who have smaller hands, and I do operate with residents who have a smaller hand size than I do. It's tough. And these staplers shouldn't be designed for 2-hand use. Unfortunately, there are a lot of people who need to use two hands. So I think that's one issue, the size of the handpiece. Another issue is when the mechanical system kicks in, the stapler jerks a little bit. And so we articulate it and turn it into a direction that we want. And sometimes we're on fragile tissue. And when you start to fire this stapler, the deployment mechanism jerks a little bit and that's frustrating because you don't want to rip tissue. I think sometimes it's frustrating also for staff because there is a learning curve and the staplers are not readily intuitive. So I have staff that I work with all the time. But if there is, let's say a change in shift or somebody who comes in to give another person a break or I'm operating late at night, and they're not familiar with that stapler system, it is not easy to just take out of the box and use. And so there are times when we can't use the stapler or we want to use a stapler, or I feel I need to use a stapler. And it can be very frustrating for other staff who aren't used to it, to use it. I think those are the biggest frustrations.

The handpiece has controls and the surgeon has a lot of degree of freedom with that said, the toggle switch is not as sensitive as you would like. And so you can open this stapler, you can close it. And then the same finger piece, you turn it right and left to angle the stapler one direction or another. There are many times where even experienced, as I am with the stapler, I want to open it, but then I accidentally turn it or I want to turn it and angle it right or left and it opens it. And for some of my residents, even good experienced residents, I'll say turn it to the right and next thing you know the stapler as closing-- that can be frustrating. And there's also another knob for turning it around along the z-axis, you can spin it around. The issue with that is, again, it's not that intuitive and then it's hard to do with one hand. You have to have a thumb and a handpiece that's long enough that you don't lose control of the stapler while also allowing your thumb to move over to toggle. And that's even similar with the right, left, up and down. It's controlled with your forefinger, but you have to have a fairly strong forefinger to do that and that's why even I in, you know, difficult locations, I'll need to revert to two hands, which can be frustrating.

What improvements can be made to surgical staplers?

Well, I think there's always- as far as what there is to do and improve upon- none of these devices are perfect. I think there's always room for improvement. The devices that we have now should be as- they should be as primitive in 10 years from now as the ones 10 years ago are to me now. I really would never use any of the staplers from 10 years ago now. And I feel like as excited as I am about some of the devices we have now, that's the way I should feel in 10 years from now. I should be looking back on these staplers saying I can't believe we didn't have X, Y, and Z. And I don't always know what X, Y, and Z is. I do know that the handpiece needs to be a little bit smaller. The toggle switches need to be a little bit more sensitive. The mechanics need to be smoothed out. I think that there are ways of making it a little bit more user friendly. There's gotta be a better way of measuring tissue above and beyond what we're currently doing. It's still in some ways is a little primitive, where we have to decide between these big differences of a vascular stapler, medium intestinal, and a larger stapler. Just seems like the technology can be a little bit improved upon.