Digestion: Small and Large Intestines Anatomy and Physiology

Transcript

Hello and welcome to the Institute of Nutritional Endocrinology's presentation on 'Digestion: the Large and Small Intestine Anatomy.' I'm Dr. Ritamarie Loscalzo, and I love to present this stuff to you. I know I like to geek out on anatomy and physiology and biochemistry, but I really do believe it's at the heart of you being able to fully understand how this magical body gets put together and how you can best help your clients.

To really have this stuff as part of your core, you have to hear it over and over again. I've been listening to an herbal materia medica set that I've been listening to, and I've been listening to these two on liver. There's some really nice stuff on some of the herbs that I hadn't used before.

The ones that I use, I really have down, but I'm also getting little distinctions about those as well. But I've listened to it about 5 times now, because I always listen when I'm driving and I don't have time to take notes while I'm doing it. So, I figure, "Well, I might as well just listen to it over and over again," because once I get to the sixth or seventh or eighth time listening most likely I'll have it memorized.

So, that's the way you can be with this information, and I've given it to you in a lot of different ways. The more you get exposed to this information, and then when we do case studies.

So, let's get started. We're moving into the lower part of the digestive tract. We did the upper part of the small intestine, called the duodenum, where the digestion happens. Now, we're going to go into where the absorption happens, and that's in the lower part.

So, before we begin, let's just make sure that you're aware that any of the information I'm presenting here is not intended to replace a one-on-one relationship with a qualified healthcare professional. It's also not medical advice. When you're presenting to your clients, you need to be really careful and make sure that they are aware that what you're presenting, and what I'm presenting here today, is intended as a sharing of my knowledge, information, clinical research, and clinical experience over many years.

I encourage you, and you should encourage your clients, to make their own healthcare decisions, based upon your research and in partnership with a qualified healthcare professional. This is especially true for folks who are on any medications.

Just want to make sure that the things that we talk about in terms of nutrition are not going to interfere with the protocols.

So, we're going to start with the small intestine. What you're seeing in this picture is, remarking right here, that is part of the large intestine that should come around and cover over like that and come down. So, this piece that I'm going to highlight in blue is your small intestine. All of this stuff down here, all through, is all your jejunum. Put a 'j' there. When you get down towards the very end here, where it hooks into the large intestine, that's the ileum.

Let's talk about the large and the small intestine. I'm going to give you, again, the anatomies, some specifics about them. I'm going to give you the physiology, we'll talk about the pathophysiology, which remember that's the disease, when they go wrong what are they functioning like. Then, we'll talk about how we're going to correct it, how we're going to deal with people, when we're dealing in the real world with people.

I really love finding go pictures, photos, so that you can actually see what's going on. That's why I highly advise you to watch some of those videos, because you can actually see the insides and see the motion and see what we're talking about when we say villi and microvilli, what do we really mean.

Overall, your small intestine is about 18 feet long. It could be longer in some folks, it's obviously not going to be 18 feet exactly in every person, because if one person is 5'7" and another person is 4'2" they'll probably have different lengths of small intestine, wouldn't you think? But the average is about 18 feet long, and it's an average of 1-inch in diameter. It's actually stated in terms of centimeters as 2.5 to 3 centimeters.

It's there. It's wound around itself, you saw in that first picture. It's just wound around itself in this cavity, and it's kind of amazing that we can fit an 18 foot tube that's 1-inch long in our bellies ... And not have them sticking out like watermelon.

So, how does this happen and how does this work? Remember we talked about how the pH of the stomach was around 2. The pH of the small intestine is around 8. We've already talked about the duodenum, which does the digestion part, the break the food down into smaller and smaller particles, that's the first 10 inches. It's a little bit less than a foot. That's the surface- that's not very long compared to 18 feet. So, the majority of the small intestine is clearly the jejunum, and it's giving plenty of opportunity for absorption to happen ... Also, plenty of opportunity for problems to happen as well. Plenty of places where leaky gut can be happening, around and around and around.

The way that the jejunum absorbs, and does so while the food is traveling through fairly rapidly, is they have something called villi. This is- over here where my highlighter is right here, this is the opening. This is a round circle, they've cut it away and you can see what's inside, and this things at the end that are sticking up, these are your villi.

You see these little- I'll get a different color, I'll get blue. That's the villi, but these little hairs sticking up off the villi are the microvilli. So, all told, we have millions of these microvilli, and we have thousands, I'm sure, hundreds of thousands maybe, of these villi and each one has dozens and dozens and dozens of these.

If you were to stretch out the small intestine, see how it's opened, right? That's just on one plane. If you were to stretch out the villi and the microvilli, it's as big as a football field or maybe bigger. It's really big. So, you have a lot of room for absorption to happen.

If it was just flat, it would just be this 18-foot tube or whatever 16 feet of absorption surface, and you wouldn't have all that much time for the food to get really well absorbed. But, because of these finger-like projections, and they're able to snap things up, has direct connection into the blood vessel and we'll see that when we look at this in more detail.

Within each of those villi are capillaries that absorb amino acids, vitamins and monosaccharides, which monosaccharides would be like- polysaccharides, monosaccharides, it's one sugar molecule, polysaccharides are multiple. So, if you go up here, you see the vessels. The blue going up, and the red coming down. One's a vein, and one's an artery. Really they're not veins and arteries, they're really venules and arterioles, which are basically like capillaries. They're very small. But, the blue ones are what takes blood back to the heart, and the red one is what takes blood from the heart to here.

Basically, the red, the blood comes in on the red train, and it grabs all these nutrients that have just flowed through our microvilli. See these microvilli, I'm outlining them. So, these nutrients have flooded into the blood vessel from the microvilli, and the blood goes back. It gives its oxygen to the tissue, because the villi need that oxygen, they need the nourishment, but then it takes away the nutrients that the microvilli and the villi have just put in there. It's really this fascinating little structure.

There's also something called lacteals. They absorb fatty acids in your glycerol, and they send them into the lymphatic system.

If we look, this is a close-up at the far end of what- these things are enterocytes. Each cell is an enterocyte, has a nucleus and it has mitochondria and all that stuff, and it has the microvilli. Here's a close-up of the villi itself. You can see the hair-like projections.

It's really a fascinating and beautifully designed system that allows us to just extract all this nutrition from food ... When it's working right. When it's working right, yes.

Here's a little bit closer up of it. Same thing, you can the hair-like projections, and then you can see the microvilli. Actually, this thing is the microvilli. So, this is a villi, and each one of these is put up here. This is your microvilli. See how clustered they are together, this is a whole bunch of them. I may have said it incorrectly now that I think back.

All right, and lacteal is this little guy in the middle. That's the lymphatic which carries away the fat in the glycerol ... It's very efficient when it works. Here again, you can look closer at the enterocyte and the little microvilli here, and it's taking- right over here, this is all the stuff in your digestive tract, and all the little nutrients are floating by.

Then, on the red side, I'll just make that a blood vessel, your blood stream, right? There's a blood supply in here, which is what we saw in that other one. It takes that and dumps it into the blood supply, into the full blood stream.

That's a close-up, I think this is one of those sort of micrographs, which actually what it really looks like. They're really cool looking. I don't know how many times blown-up that is, but probably a lot, like millions.

This is a little peek inside the small intestine. So, this is what it looks like. You see the glistening. The glistening is your mucus. That's the protection.

And that's the folds, it's folded all around each other. That's what the lumen looks like. That's where the food passes through. There's some really good pictures on the videos that I put up on the page, on the website.

We're going to take a look at one now, just so that you get a sense of how these enterocytes work and how the absorption works.

Video: *Intestine is characterized by numerous circular folds called plicae circulares. The plicae are lined with finger-like villi. From a cross-sectional view, the villus contains a network of capillaries which surround a specialized lymphatic vessel known as a lacteal.*

The epithelium of an intestinal villus consists of columnar cells which are covered with microvilli. This succession of folds and projections increases the surface of the intestinal lining for efficient absorption.

Carbohydrate digestion is completed by enzymes in the small intestine. Carbohydrates are absorbed by the villi and then enter the capillary.

Fat digestion occurs primarily in the small intestine. Fat molecules are digested and absorbed into the epithelial cells of the villus. The fats are formed into clusters called chylomicrons, which pass into the lacteal. Lymph carries chylomicrons away from the villus.

Protein digestion is completed in the small intestine. Proteins are broken down first into peptides, then into amino acids. These are absorbed into the villi, then into the capillary.

Let's look at the large intestine. Then we'll talk about how they work, and then we'll talk about what can do wrong.

The large intestine, in contrast to the small- we think about the large intestine, a lot of people think, "Well, the large intestine must be larger." Well, the large intestine is larger in diameter, but it's shorter in length. It's about 4-4.5 feet, 1.5 meters. It's about 5 centimeters in diameter, which is about twice the diameter of the small intestine. So, it's about 2 inches wide versus 1-inch wide. There abouts, give or take.

The function of the large intestine is actually just to absorb water, absorb a few remaining minerals out of the food that's passing through, and eliminate wastes. In addition, it has the ability- it contains bacteria that will make Vitamin K and Vitamin B for us.

So, it's got a significant role. It's not just this passive tube that's just a bunch of waste, it does do some work. Think about it. When the bolus of food goes into the large intestine, it's kind of liquidy. It's been slopped around, and it's gotten all these juices added to it, it's pretty liquidy until it gets into the large intestine. The large intestine's job is pretty important is to concentrate it so that it can come back out the other way.

The last part, which is hard to see here, this is the sigmoid colon, where it's circling. The last part is the rectum, and the rectum is actually more of a, like a chamber almost, where poop can sit. You have feces going through it. It comes into the chamber, and it just sits there, waiting for a convenient time. It causes you to get that reflex that says, "Hey, time to go." But, it doesn't just force it's way out unless there's some kind of problem or there's something irritating in there. That's kind of a waiting chamber for you.

I think that's it. What else- So when we enter, we enter from the ileum of the small intestine through a valve called the ileocecal valve. I have a better picture of it up later, right there is where the small intestine comes in and that's the ileocecal valve in there. The ileocecal valve is supposed to be a one-way valve. It allows contents to enter from the small intestine into the large intestine, and then it closes and waits to be tapped on again until the the next round comes along.

But, we'll see in a bit, one of the dysfunctions that can happen is the ileocecal valve can get stuck in the open position and what does is allows a back-flow of contents from the large intestine into the small intestine. It can also get stuck shut, which means that you may start to feel some expansion, bloating, in your small intestine, but you're not able to have a bowel movement because there's not very much in your large intestine. It's not getting through because of that valve being stuck shut.

So, it passes from the ileum into this little place called the cecum. This little appendage, I'll mark it in blue, right here, is the appendix. Look how tiny that guy is. That tiny little appendix can cause so much trouble. It's lymphatic tissue really. The reason is causes trouble most likely is that people are not living in accordance to what they should be doing in terms of diet and lifestyle. Being exposed to lots of toxins, the immune system is having to work really hard, and it bursts or gets infected.

Your food makes its way up, and we're calling it food but it's no longer food, it's chime, chyme, actually chyme is the way you say it, goes up the ascending colon, goes across the transverse colon. It goes down the descending colon into the sigmoid colon. Then it goes it goes into the rectum, and then comes out the anus.

Let's talk briefly about the appendix. You can see this is just a blow-up of what I just showed before, this is the appendix. There's the appendix, there's the ileum, and there's the cecum. This is the ascending colon.

So, it's just tiny. It's barely 4 inches long. It's very controversial. Some people say it's a decidual organ, it means that we don't need it anymore. Yet, a lot of people have it get inflamed and they have to have it surgically removed. I had mine surgically removed, even though it wasn't inflamed, but that's a long story. We'll share that another time. But they think about it as, 'Oh well, as long as you're in doing surgery on somebody for something, you might as well take the appendix because they don't need it.' ... That's kind of what happened to me. I got my appendix stolen from me.

So, lymphatic tissue. It helps to protect you. It also is believed to act like a good bacteria factory, and it cultivates good bacteria which it then can feed to the rest of the colon. That's kind of new, that's something I just read recently since studies- I haven't read that before or heard that before. I've always heard of it as being just lymphoid cells, which help with the immunity in your gut.

Here's kind of a close-up of the ileocecal valve, although this isn't the best of all sides. But, you can see the opening right there. You see? That's the ileocecal valve. It's supposes to be a one-way valve that goes from the small intestine to the large intestine.

Then again, the large intestine parts, we've already reviewed them. It's the over and over again, repeat, repeat, repeat, so that you get it. Cecum is the first- the lower part. The ascending colon, the transverse colon, and the lower- the sigmoid, and then the rectum. And then the anus is the exit. So, it's mouth-to-anus is the trip.