## Liver Abscesses in the Beef Industry: Dr. Ty Lawrence

## Season 1, Episode 37

[Intro music]

**Kiernan Brandt :**

[Music] Welcome to Cattle HQ, a podcast from industry experts and progressive producers discussing cutting-edge info about the cow/calf sector to keep cattlemen and women in the know and positively affect their bottom line.

**Robin Silverson:**

Welcome to Cattle HQ, brought to you by South Dakota State University extension. I am Robin Silverson, cow/calf field specialist based out of Lemmon. Joining me to host this episode is Sydni Borders. Sydni is a PhD student here at SDSU and was also a guest on Cattle HQ talking about the 2022 BQ8 Audit. So, I’m very thankful that she is joining me here today. I’m also excited to have Doctor Ty Lawrence from West Texas A&M talking about the issue of liver abscesses in the beef industry. So, I just want to turn it over to Sydni because this is an area that she became very familiar with when she was doing the BQ8 Audit. So, Sydni, I’m going to turn it over to you.

**Sydni Borders:**

Thank you so much for taking the time to be here with us today. I know that you and your team have done a lot of extensive research on liver abscesses. So, we’re super grateful to have you here. As Robin previously mentioned and we’ve talked about in a previous episode with the 2022 Nation Beef Quality Audit, that audit found that liver abscesses are one of the leading causes for liver condemnation. That accounts for approximately 20% in both the fed steer and heifer side as well as the market cow and bull. So, it’s become an issue. That’s become a hot topic in the US beef industry. Doctor Lawrence, we were wondering if you would just be able to start off by talking about what exactly is a liver abscess and what are the causes behind that.

**Ty Lawrence:**

Sure. So, a liver abscess is – it’s a pocket. Some people would call it a pustule. The abscess itself is mostly white blood cells and byproducts of the immune reaction of the body trying to fight an infection in the liver. So, let’s back up and step into how that happened. So, the liver is a filter. It’s also a tremendous metabolic organ that is altering nutrients, generating nutrients, and creating a whole host of metabolic actions and reactions for the function of the living organism. As part of its function, the liver receives blood flow from the portal vein. Well, the portal vein drains almost the entire gastrointestinal tract of an animal. So, if items other than nutrients, and I want to refer to bacteria here, escape the gastrointestinal tract and enter the portal vein, they will be trapped, caught, filtered, and excluded in the liver. So, when we have bacteria leaving the GI tract, they get filtered out in the liver. Some of these bacteria are very virulent. They have the ability to fight the immune system, and in many cases, win. One of the primary bacteria that we are concerned about in that give and take that I just mentioned is called Fusobacterium necrophorum. It has been shown time and again to be a dominant bacterium in liver abscesses. But I do want to also preface that it’s not a sole bacterium. If you were to culture what is in a liver abscess, you would almost always call that a polymicrobial infection, in which there are many different family, different phyla, different genus, different species of bacteria. But most of the industry has focused on Fusobacterium necrophorum as the primary cause. Multiple experiments conducted primarily by Doctor T.G. Nagaraja at Kansas State have demonstrated that injecting a Fusobacterium necrophorum into the portal vein and/or inoculating cattle with Fusobacterium necrophorum can certainly cause liver abscesses. So, we know that is one of at least multiple mechanisms that’s highly likely. Something that – I’ll go into a little history here. For most of cattle feeding and beef production history, we have all assumed that Fusobacterium escaped the GI tract in the rumen and/or the four compartment stomach primarily through the rumen. However, more recent evidence suggests that it might also be escaping through the small and/or large intestine. Then, we may have many more options for the GI tract to leak if you will or allow bacteria to escape and then get to the liver, thus causing that infection. Now, once that bacteria gets to the liver, it is extremely virulent. The important part here is that the Fusobacterium are able to overtake the innate immune system via the white blood cells. That’s why the liver abscess itself is largely a collection of inactivated white blood cells and other immune products. So, the body is fighting an active infection in its liver while it’s also trying to metabolize nutrients. So, in cattle with severe liver abscesses, we typically see some level of muted growth in that they typically weigh less as carcasses and as live animals. They typically deposit less back fat. They typically have smaller ribeyes than an animal with a healthy liver. So, in really severe cases, we see that that infection diminishes their productivity.

**Sydni Borders:**

Right. Along with that, the diminished productivity, live performance as well as what you see on the carcass side of things, are there any other traits or ways to detect liver abscesses in live cattle or is it one of those things where you sell those cattle, they go to harvest, and you see that they didn’t perform as well, or they have the liver abscess present at the time of evisceration?

**Ty Lawrence:**

So, Sydni, in gross visual observation, think livestock judging or live animal evaluation, there’s absolutely no way to tell that an animal has a liver abscess. In fact, the animal itself probably doesn’t know it has an abscess because the liver doesn’t have any pain receptors. So, it’s not a painful process for the animal to have an abscess. However, abscesses can sometimes be detected via ultrasound. In a feeder calf, an animal that’s thinner in flesh, and lighter in weight, and literally would have a thinner body wall, an abscess can be detected. Some of my colleagues have done that in recent months and years. However, as the animal gets larger and larger, and fatter and fatter, the abscess has become more difficult to detect with ultrasound. In a finished animal, you can probably see about 40% of the liver via ultrasound technology. So, it’s possible to detect it with ultrasound, but there could be a decent rate of false negatives because of the 60% or so of the liver that cannot be seen with ultrasound technology. There’s also been bloodwork examinations done. So, you bleed an animal and then you evaluate multiple markers. There is some plausibility that yes, you could detect it with blood work. One of the bigger questions and without a good answer is if we detected it with ultrasound or if we detected it with bloodwork, what are you going to do? So, an animal has one. If it’s a minor abscess, we think they can probably heal and resolve in the course of maybe up to six weeks or less. However, if it’s a major severe abscess, many of us are suspicious that that may never resolve. So, we don’t really have a great answer as to what to do if we’re able to detect this in a living animal.

**Robin Silverson:**

So, Doctor Lawrence, it’s interesting that you said that research are showing into the small intestines because I just recently – I’m trying to learn more about liver abscesses for this podcast to tell you the truth, and there was just a project I was reading that they were – it was an older research project, but we’re uncertain on the absorption rate past the stomach of the animal. So, that’s interesting that you mentioned that because it was in my mind to tell you the truth. So, I appreciate that. My question also for you then is I know there’s different levels of – excuse me. Different levels of liver abscesses. There’s that grading system, if you want to call it that. How long does it take for even the most minor live abscesses to occur to those ones that, like you just mentioned, will never potentially be able to go away. Does that make sense, Doctor Lawrence?

**Ty Lawrence:**

Absolutely. So, through collaborative research that I’ve been a part of, we know that an abscess can form in as little as two weeks. Well, I say form and be detected in as little as two weeks. So, in theory, there may be a few days less than that for it to actually form and be seen. It’s probably the known minimum. There could be somebody out there that’s illustrated a study that’s 10 or 12 days. But within the course of a few days to weeks, they can be detected.

**Robin Silverson:**

So, what’s causing these abscesses then? I mean obviously, it’s metabolic. So, there’s things happening. Can you tell the audience what is causing these abscesses to occur?

**Ty Lawrence:**

So, the abscess is the escaping of the bacteria out of the gastrointestinal tract and then entering the liver. The liver immune system recognizes that the bacteria are not cell. They’re not part of the innate body and the liver wants to get rid of them. But the virulence of the bacteria – so, let me back up a minute. The immune system sends white blood cells to phagocytize these bacteria which basically means to eat them and trap them within the white blood cell. Then, in a normal immune system, white blood cell would go on and be contained in lymph and lymph nodes. In the case of liver abscesses, the bacteria have virulent mechanisms that are able to inactivate the white blood cells. So, then another one gets sent. Then, it gets inactivated. Another one, and another one, and hundreds of thousands and millions more until all of a sudden, you have an area within the liver that is no longer liver tissue. This area, and the area could be as small as the head of a pen. Almost microscopic. Or the area could be larger than a basketball. Everything in between exists in biology that is seen everyday at a slaughterhouse. So, the range of how much material has been accumulated in a liver, varies widely. But for us to see baseball size, golf ball size abscesses would be very normal every day of the year. Then you see some very fantastic examples where you kind of wonder at times how the animal was still living and metabolizing nutrients because it’s finding such a large infection.

**Sydni Borders:**

Typically, these abscesses, a lot of times when you read about them online in different magazines and stuff, they tend to be associated with cattle that are fed on a high concentrate diet. So, my question for you Doctor Lawrence is: Is there a correlation between high concentrate diets in feedlot cattle versus the rates that you’re seeing in market cows and bulls? What could be potentially causing those? Because they’re more on a roughage-based diet as compared to concentrate.

**Ty Lawrence:**

Absolutely. So, research that our team published just a few years ago said that a cull ranged cow, so think yellow fat, orange fat ranged cow exhibits a liver abscess at a rate of 16%. Whereas a dairy cow fed a higher – actually fed a diet and it being somewhat inclusive of concentrate had a liver abscess at the rate of 19%. Whereas a native steer or a heifer is probably in the 20% to 26%, 27% range from the same type of beef animal. So, the difference is the diet. That’s a big difference between fed steers and heifers an cull cows and bulls. But you got to wonder what’s going on in the cull cow and bull. 16% of them have a liver abscess. So, it’s probably something other than diet that is a maybe. In the case of the ranged cow and of the dairy cow, I’m going to opine with no evidence that it may be the consumption of rough porridges. So, if you have a cow that is eating very fibrous, stiff, rough porridge and you have an abrasion of the lips, cheeks, gum, esophagus, that abrasion could allow the bacteria out of the GI tract and into the portal vein. In a traditional yellow fat ranged cow, it’s probably not an acidotic reaction that cause the leakage of the gut. It might be stress, maybe weather stress, maybe reproductive stress, environmental stress later that cause the perforation or leakage, if you will, of the intestines. But the rumen is not likely to cause in those – for sure, in the range cow, and a lesser likely cause in the dairy cow.

**Robin Silverson:**

So, those animals that are out and those cows that are out on corn stalk for instance, would that be a possible cause then if you’re talking about a rough porridge?

**Ty Lawrence:**

That could be a risk. Yes. So, any force that would potentially cause abrasions of the GI tract would allow for bacteria to escape the GI tract.

**Robin Silverson:**

That’s interesting. That’s a really interesting comment, Doctor Lawrence. They never thought about it that way. It’s more of an abrasion around the small or through the small intestine and intestinal tract. That’s very interesting and I think it’s important because of the leaking.

**Ty Lawrence:**

It could start as early as the mouth, lips, cheeks, gums with eating a very abrasive roughage. The animal might not have to bleed. But if you cause enough of an abrasion to see blood, then obviously, bacteria can go the other way.

**Sydni Borders:**

Right. So, along with that point and the fact that they’re being seen across a variety of different types of cattle, previous research has indicated that cattle of different origins, different breeds that come from different feedlots typically could be more prone to getting liver abscesses compared to other breeds. So, I was wondering if you could elaborate a little bit more on the differences that you’ve seen specifically in cattle of different origins and how you’re seeing different rates from cattle that come from different places.

**Ty Lawrence:**

Yes. So, of all cattle rearing opportunities, the greatest risk for liver abscesses are cattle reared in a dairy. So, in dairy cattle, we remove the calf from its dam at day one, maybe hour one, maybe minute one, depending on the dairy. Then, that calf is reared completely different than a traditional beef type ranged calf. They’re traditionally held off of milk as soon as possible and put on to a concentrate diet as soon as possible. Then, they’re fed by a human arguably for their entire life. So, more days on a concentrate ration is a much higher risk than less days on a concentrate ration. So, the feeding management system and the rumen health differences between the dairy reared calf and the ranch reared calf is fundamentally the reason that we see so many in the dairy reared system.

**Sydni Borders:**

Okay. [Laughter]

**Robin Silverson:**

I’m sorry, Sydni. So, we’ve been talking about how abscesses occur, why they occur, what it means. But what does it mean on an economic standpoint for the beef industry?

**Ty Lawrence:**

Great question. So, if I were to pull up a USDA market news report and you look at value of products that would come from fabrication. So, think ribeye roll, eye-of-round roast, shoulder clod, things like that, you would see a whole litany of products. One of the products that we remove from beef carcasses is outside skirt meat which you and I Sydni know as diaphragm, and the consuming public knows as the heat of meat. Well, in liver abscess cases, many of those animals, the liver abscess adheres via fibrin connective tissue as part of the immune reaction to the diaphragm. In those cases, the liver is removed and the diaphragm is removed from that animal. That can cause the packer unintended consequences. So, in the summertime, think May through about September, the heat of meat or outside skirt meat sells second in price only to tenderloin. So, you might be paying $17.00 a pound for your wholesale tenderloin. You might be paying $15.00 a pound for your wholesale skirt meat. So, all of a sudden, everytime you have a severe liver abscess, you just cut off your second most valuable product and you throw it into meat and bone meat. So, that’s a financial loss immediately. Secondly to that is many packers have found themselves shorting orders. So, you have an order, and you know everyday you’re going to kill 4,000, or 5,000, or 6,000 cattle at a given production facility. So, you presell all of that meat. So, if I’m slaughtering 5,000 cattle a day, well I’m going to sell the outside skirt meat of those 5,000 cows. Well then, I find myself if I have a severe abscess day only having 3,000 skirts to sell, well, I’m shorting orders for 2,000 people or 2,000 skirt meat. So, I literally had conversations with beef processing plant managers who have told me on multiple occasions that’s been a real issue in recent years because our liver abscess rates are so high, they’re shorting orders for products they intended to have but didn’t because of abscesses. Likewise, if the abscess ruptures and the pustule is onto the carcass, now according to USDA regulations, that must be cut off. You can’t wash it off. So, we’re now cutting maybe the inside of the cavity off. Maybe we’re cutting the brisket off. Maybe we’re cutting the shanks off. Maybe we’re cutting the flank off. In many cases, the carcass will weigh tens to hundreds of pounds less because of the ruptured abscess. So, depending on the sales mechanism, that could either be the producer’s burden, economic burden, or could be the processor’s economic burden depending on who own the animal at the time when it cross the hot skid.

**Robin Silverson:**

So, along with the economic burden of trimmed out value, you previously mentioned that there’s also some performance differences in cattle with those major liver abscesses. So, does that become a factor into the economic implications of this problem as well?

**Ty Lawrence:**

It does. There’s a litany of data that illustrates animals with severe liver abscess. So, anything we call the A plus score or worse, they’re growing at a muted level compared to minor abscesses which are growing slightly slower and slightly less efficiently than animals with none. So, the more severe it is, the lesser, light weight an animal would be, the lesser carcass weight, the lesser back fat thickness, the lesser ribeye. So, you’re literally selling a smaller lighter weight, leaner animal and that grew slower. What we don’t have great data for is efficiency feeding gain on those type of animals just because of the difficulty in acquiring those information.

**Robin Silverson:**

Right. So, moving forward with this, obviously, it’s an issue that has huge implications for both the feeder as well as the packer. But moving forward with this issue, where do you see our industry going as far as trying to control these instances of liver abscesses and how to mitigate these problems.

**Ty Lawrence:**

That’s a big unknown. So, I’ll tell you where we are today. We’re in a place where the vast majority and I’m going to guess approximately 90% or more of the industry would utilize the antimicrobial tylosin phosphate. So, it’s marketed and sold by two different companies. But it is an antibiotic, put into the feed to reduce the prevalence and severity of liver abscesses in finished cattle. There have been multiple attempts to produce a vaccine either a toxoid, a bacterin toxoid, or a bacterin itself to vaccinate against the liver abscess. Even though some of those small trials looked promising, at commercial feels scale level, they just absolutely don’t work at all. They don’t really provide any meaningful benefit. So, the current option is really an antimicrobial. Tylosin phosphate would be the dominant option to do that. For cattle that are fed in Canada, you might see some chlortetracycline used for the same manner. But it typically isn’t used in the United States for that purpose. So, we have an antimicrobial option that works, and it reduces liver abscesses. That’s well-documented and well-repeatable. We’ve tried vaccines and they’ve not worked well thus far. I suspect people will continue to attempt vaccines. I hope they do. Maybe we can find one that is meaningful, and applicable, and repeatable not just in the small trial but in large field applications. Right now, that’s kind of the crux of technology. Some people have tried to mitigate liver abscesses by tweaking porridge and concentrate ratios. A little bit, some people tried it with timing. So, I’m going to say that a lot of this has to do with nutritional gut health and gut health management. Appropriate gut health management looks a whole lot different at the gut table during harvest. Then, lack of the health management when an animal gets to the gut table. I can usually tell the difference pretty quickly, pen by pen, feed yard by feed yard on how those cattle have been managed.

**Robin Silverson:**

So, I just have one last question, at least from me, Sydni and that is as you’re talking about antimicrobial use to help mitigate these abscesses, but we know that regulations are becoming stricter and stricter with the use of antimicrobials I think will change. As you said, people are looking more at the nutrition side of things and timing, and the ratio between porridges and concentrate. Do you see that in research becoming more dominant or more prevalent looking at things like that versus antimicrobial use?

**Ty Lawrence:**

So, it depends on who you are. There are multiple groups in the industry that are working on both of those outcomes. I know and work with groups that are working to develop new antimicrobials to mitigate liver abscesses. I know and work with groups who are trying to mitigate abscesses with nutrition. Those people might not agree with each other, but I’m fortunate to get to work with all of them. I could tell you if we were to do nothing nutritionally and stop using the one antibiotic that is widely used today on a pen basis, you’d probably see abscesses bump between 10% and 50% overnight. That depends on the diet and the management that you have today versus if you change nothing and you just took that one item out of your diet, it will get worse instantly. How much worse it gets depends on how you’re doing right now.

**Robin Silverson:**

I appreciate that comment, Doctor Lawrence. It’s about time to wrap up this podcast. So, Sydni, do you have any additional questions, comments, thoughts?

**Sydni Borders:**

No. I don’t. I know I certainly learned a lot. So, thank you so much, Doctor Lawrence for being a part of this.

**Robin Silverson:**

Well, thank you to both Sydni and Doctor Lawrence for joining me on this episode. This has been Cattle HQ brought to you by SDSU extension, headquarters for all things beef cattle. Visit extension.sdstate@edu for the latest beef information. Until the next episode, remember, the cheapest way to improve your look is to wear a smile.

**Kiernan Brandt :**

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[Outro music]