‘Brisket Disease’ Research

Now Includes a Look at Feedlot Heart Failure

Brisket disease is taking many geographic regions by storm and causing major losses in some feedyards.

by ***Heather Smith Thomas***

Some cattle at high elevations suffer from pulmonary artery hypertension, which leads to congestive heart failure. Also dubbed brisket disease, mountain sickness, big brisket or high mountain disease, this condition results in lethargy and swelling in the neck and brisket due to high blood pressure forcing fluid out of the blood vessels and into surrounding tissues. Swelling may spread up the neck or under the belly. If not reversed, the condition is fatal. Because outward signs are not always present, a producer runs the risk of losing an animal without realizing it needed treatment.

Cattle living at elevations above 5,000 feet are most at risk, and incidence of brisket disease increases at higher elevations, as low oxygen availability triggers the problem. Affected animals may have problems early in life if they live at a high elevation or develop this condition if brought to high elevation from lower altitudes. Susceptibility seems to be inherited.

A test can be performed to determine whether a certain animal will be at risk. For nearly 40 years, Tim Holt, DVM, Colorado State University (CSU) Department of Clinical Sciences, has been testing cattle living at sea level and up to 15,000 feet elevation. The test used was initially developed for humans in order to measure pulmonary artery pressure (PAP).

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Holt explains that lack of oxygen at high elevations causes the inner diameters of small arteries in the lungs to contract. The muscle layer in the artery wall thickens, reducing blood flow into and through the lungs, causing an increase in blood pressure. The smaller the diameter of these vessels, the greater the pressure within them. The extra effort needed to pump blood through these restricted arteries causes an enlargement of the right side of the heart; eventually the right ventricle loses its ability to contract. As blood pressure increases and blood starts to back up into the heart, the pressure can blow out the valves of the right ventricle.

“The animal gets high blood pressure on the right side of the heart,” Holt says. “The PAP test measures that pressure in the lungs and the blood flow resistance in those arteries, making it possible to predict an animal’s welfare at high altitudes. There are several reasons an animal may develop this problem, but the big reason is genetic susceptibility.”

A few breeds are slightly less susceptible, on average, but brisket disease has been seen in all breeds. “Cattle that have been at high elevation for many generations have no problems. When I went to Ethiopia, I found cattle grazing at 10,000 to 14,000 feet that did not have high pulmonary artery pressure,” Holt recalls. It is hypothesized that any susceptible cattle in that region died long ago and did not pass the tendency to offspring.

In North America, beef cattle have been selected for meat production, fertility, etc. but with little attention paid to how they function at high altitudes. Therefore, this genetic problem is found in many breeds and bloodlines used today. Most cattle in the U.S. live at lower elevations, so there is no natural selection to eliminate the problem. The PAP test can identify the resistant as well as the at-risk animals to aid ranchers at high elevations in selecting more naturally resistant animals to use for breeding stock.

Milt Thomas, Ph.D., and John E. Rouse Chair of Beef Cattle Breeding and Genetics, CSU Department of Animal Sciences, says we now split this disease into two categories — high mountain disease and feedlot heart disease — and they are not the same disease. Many people are aware of high mountain disease, but only recently have researchers discovered the feedlot problem.

Genetics of high mountain disease

“Here at our CSU facility at the Beef Improvement Center and at the Rouse Angus Ranch [also called the One-Bar 11 Ranch] in southern Wyoming, we spend a lot of time trying to better understand the genetics behind brisket disease,” Thomas notes.

The Angus herd at the ranch in Wyoming has been there since the 1950s. “Over time we have also created some crossbreds, with Hereford,” he says. “We work with our other CSU seedstock herds — a Hereford herd and an Angus herd — in Fort Collins, as part of our teaching program. We put some embryos in cows at the Rouse ranch and some of the Hereford cows serve as embryo donors. We get PAP measures on some of the Hereford cattle because they begin their life up there in Wyoming.”

Thomas’ team published a paper a few years ago from the Four Corners Bull

Test looking at the breed effect, but data only reflected the individual bulls brought to that test. He explains all breeds were different and some had better results than others, but it all depended on who brought bulls to the test.

As a result, the team is doing lots of DNA research; however, it has not been applied to the industry just yet. Some associations have started developing an expected progeny difference (EPD) for PAP, but that work is still in the early stages.

Even so, there is no doubt in Thomas' mind such an EPD is greatly needed. "We've been doing PAP EPDs for a long time at the Colorado Beef Improvement Center, but only for the bulls that came from semen companies that contributed semen to our breeding program," he says. "Companies like ABS, Select Sires and Genex® have given us a certain number of bulls each year to breed. The PAP EPDs have been private information for those semen companies."

However, with their success, the future looks bright for the PAP EPD within different breed associations. While the EPD is not developed completely in all arenas, the research unveiled other valuable information.

Another thing researchers have learned is that within high mountain disease there is a difference between what is called high altitude and what is called moderate altitude. "This is something that Tim Holt felt was true, for a long time," Thomas reflects. "Above about 5,000 to 6,000 feet in elevation, these animals will experience the stress of altitude, but there are many cattle being PAP tested at what we call moderate altitudes. For instance, here in Fort Collins we are at about 4,000 feet. The best [most reliable] PAP scores are those taken at above 6,000 feet. We can use data from tests taken at moderate altitudes, but it's not as accurate."

Congestive heart failure in feedlot cattle

Greta Krafsur, DVM and diplomate of the American College of Veterinary Pathologists at CSU, says high mountain disease continues to be a disease exclusively affecting pulmonary arterial circulation, and, hence, the right ventricle of the heart.

Bovine congestive heart failure (BCHF) is now recognized as an increasingly apparent disease in feedlot cattle, particularly in the Western Great Plains of the U.S. and Canada. BCHF is an untreatable, fatal condition involving pulmonary hypertension that results in right ventricular failure, but it may begin with left-heart dysfunction in many cases that occur at low and moderate altitudes. Because BCHF affects both sides of the heart, it is different from right-heart failure at high altitudes.

Krafsur has made congestive heart failure in feedlot cattle the subject of her doctorate dissertation research. Currently employed by the University of Colorado-Denver Anschutz School of Medicine Cardiovascular Pulmonary Research Lab, she works alongside human physician scientists, whose expertise in pulmonary hypertension and heart disease have greatly influenced her thinking regarding the complex problem of BCHF.

"Clinically these conditions [high mountain disease and BCHF in feedlot cattle] look the same," Krafsur says. "These cattle have brisket edema, belly edema, bounding jugular pulses and may have diarrhea. They start losing weight and their performance decreases, with diminished carcass traits." Heart problems occur earlier in life in animals suffering from high mountain disease, whereas those suffering from BCHF see problems during the finishing phase while cattle are in the feedlot.

Thomas says this is the big difference between cattle with high mountain "brisket disease" versus the feedlot cattle. "The high mountain disease can appear in a baby calf or a young bull, steer or heifer — animals that are still growing rapidly. They tend to be lean, compared to the finishing animal. The feedlot animal is a very different creature, at the top of the growth curve, becoming fat. We are feeding them to create Choice carcasses, so these cattle are big and fat."

Krafsur agrees, "This disease has created a lot of problems in feedlot cattle, particularly in situations with retained ownership. If a rancher in South Dakota at low to moderate altitude sends his weaned calves to a feed yard in the Nebraska panhandle to be finished, and the yard owner calls to tell him he lost a few cattle to what looks like brisket disease, the rancher gets upset because those cattle were raised at low elevation — so this shouldn't happen," she says.

Krafsur has conducted investigations and postmortem exams at feed yards, only to tell the cattle owner the problem was not brisket disease but something different. "We are trying to get away from people calling it brisket disease or high mountain disease. We prefer to call it Bovine Congestive Heart Failure (BCHF) because the term brisket disease is confusing," she says.

"These are two separate diseases," Thomas says. "We have done a lot of research over the years, moving cattle from the Rouse Ranch in Wyoming to the Eastern Colorado Research Center [ECRC] at Akron. We've studied the cattle to see how they get BCHF, but we always had the challenge of these cattle starting their lives at a high-altitude ranch. So now we have a USDA [United States Department of Agriculture] grant to look at this, and we purchased a set of cattle that are local to the ECRC. They have never been at high elevation; they've always been at the eastern Colorado plains elevation. We are now feeding those cattle and doing a study about feedlot heart disease using animals that have never been to a mountain ranch. This will be the big focus of our research over the next 12 months, to get the samples, and for the next three years — to accomplish this study," he says.

The researchers at CSU have also done collaborative research with the U.S. Meat Animal Research Center (USMARC) in Clay Center, Neb. In their current study, they purchased 100 Angus steers from a herd with a history of feedlot heart disease from a ranching family living at that low elevation.

A couple of these steers were included in a study that Krafsur published this past summer. "This study documents this condition in animals that are exclusively from the high plains of Nebraska, eastern Wyoming and moderate altitudes in northeastern Colorado," she says. These cattle had never been at high altitudes but still had a history of heart failure.

"We are trying to do a couple things with our current study," Thomas says. "First of all, if we talk about high PAP versus low PAP scores in feedlot steers, we don't know much about their characteristics as they go through the finishing phase. So we will bring them to Fort Collins and put them in our feed-intake unit so we can study their feed-intake characteristics. This is an interesting thing to be working on because at this point we know so little."

Once cattle are in the feed-intake unit, their daily health can be intensely monitored, and some cattle in those groups will be challenged with a respiratory virus. Thomas says with feedlot heart disease, they sometimes see what people call "late feedlot death." These cattle do not make it all the way to slaughter — they perish shortly beforehand, near the end of the finishing phase — and these are very expensive losses.

"Our hypothesis is that some of these cattle are highly stressed already [by fattening] because they are high PAP cattle, and then when they get a secondary challenge like respiratory disease, this is what pushes them over the edge," he says.

Krafsur says feedlot cowboys and pen riders are very skilled at recognizing which cattle are susceptible to BCHF and are also very good at distinguishing them from cattle with primary respiratory disease. Unfortunately, many cattle with BCHF are misclassified as ones with primary respiratory disease because often the only tissues examined at necropsy are the lungs, right ventricle of the heart and the liver. "If the diagnostic pathologist sees any sign of pneumonia in the lung, respiratory disease is thought to be the initiating factor for hypoxic pulmonary vasoconstriction leading to increased workload on the right heart, which caused backup of blood flow in the liver," she says.

Feedlot cattle that have acute respiratory disease almost always have cardiac fibrosis and a left heart dysfunction. Krafsur is certain the problem is even bigger than researchers realize because many times people do not look at the left side of the heart or the pulmonary venous circulation. Also, cattle with a cardiopulmonary disease are likely predisposed to pneumonia.

Although management and feeding regimens in feedlots are similar across the industry, there is a subset of cattle that develop BCHF for reasons unknown. "My instincts tell me that some cattle do not respond favorably to the high demands imposed by excess calories, aggressive growth and fat body condition during the feeding and fattening phase of the production cycle," Krafsur says. "This subset of cattle seem to experience systemic inflammation and metabolic and lipid dysfunction that lead to cardiopulmonary remodeling and dysfunction. This condition is invariably fatal and there is an urgent need to find biomarkers predictive of disease that can be used to assess risk and inform management decisions."

Genetic testing could enable cattlemen to pinpoint at-risk individuals. These animals could then be managed and fed differently to grow more slowly and to not become as fat — or salvaged sooner in the feeding process if they start to show signs of BCHF.

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Collaborative research

Scientists at universities in several states have been working on various aspects of genetic susceptibility to high altitude disease and BCHF. Some are collaborating with researchers in the Genetics, Breeding and Animal Health Research Unit at USMARC and with veterinary epidemiologists at the Great Plains Veterinary Educational Center (GPVEC), also in Clay Center, Neb.

An executive summary from a meeting at the GPVEC in September 2018 regarding BCHF stated the condition is appearing increasingly in feedlot cattle and that BCHF outbreaks occur even in operations feeding well-managed, high-genetic merit cattle.

According to the summary, "For some producers, it is the single most costly health-related problem, with losses exceeding $250,000 annually in individual operations, even surpassing those from bovine respiratory disease. Consequently, reducing the impact of BCHF is a high priority for the cattle industry."

A workshop of collaborators was held September 18 and 19, 2018, at the University of Nebraska-Lincoln GPVEC to review the current status of BCHF knowledge, to identify gaps and to outline a plan for moving forward. Participants included researchers, veterinarians, cattle producers, and other beef industry stakeholders. Participants identified disease pathogenesis as a major gap in BCHF knowledge including onset, progression and risk factors associated with heart failure.

Based on these knowledge gaps, the following critical needs were identified: diagnostic tests that allow rapid, early and affordable identification of diseased individuals; knowledge of risk factors for disease (genetic, environmental and management); and estimates of scope and economic impact of BCHF across North American cattle production. Meeting these critical needs will mitigate the impact of BCHF, enhance cattle health and welfare, and improve the sustainability of beef production.

"Knowledge of BCHF pathogenesis also informs an important large animal model for human congestive heart failure associated with pulmonary hypertension and left heart dysfunction, and supports an integrative, multi-disciplinary One Health approach to optimize health for both humans and animals," the summary stated.

Researchers at Clay Center have been dealing with cases of BCHF since the 1970s, but the disease is now recognized more frequently. Most of the feedlots they have been working with indicate this problem started to become more obvious about a decade ago. Some of these feedlots are at elevations as low as 1,000 to 1,500 feet, and some have experienced death losses from BCHF at a rate as high as 6 percent.

When the Nebraska researchers began collecting samples for a case-control study, they noticed these deaths were not all happening late in the feeding period. A common misconception is the condition hits fat cattle near the end of the finishing phase — just before they go to slaughter. However, these researchers have samples that show a distribution through the entire feeding period. They are currently trying to gather more data to help the beef industry better understand what it should be looking for regarding this disease.

There has been speculation amongst cattlemen that perhaps some of the traits heavily selected for in recent years — fast-growing, high-performing, rapidly fattening animals that produce a superior meat carcass in a short time on feed — may be linked to this emerging problem. Has the industry been inadvertently selecting for cattle that have a genetic susceptibility to ending up with BCHF in the feedlot?

Researchers are hoping to be able to provide the feedlot veterinarian or producer with a tool for early diagnosis.

Several researchers are looking at heavily selected traits to see if there is a genetic connection. Joseph Neary, Ph.D., Texas Tech University, has been studying the problem in feedlot cattle at low elevations for several years. His previous research looked at calf mortality due to heart failure in high altitudes even though many of the herds had been performing PAP testing.

Neary and his team followed cattle into the feeding period and looked at their pulmonary pressures in the feedyard. He says the project was quite revealing. In one study, calves from a low PAP herd at just over 7,000 feet were sampled at 4 and at 6 months of age, and their pulmonary pressures increased with age. When those calves were followed into the feeding period, their tests were lower at first — but Neary thinks this phenomenon is due to the calves being at a lower elevation for feeding. Then, their pulmonary pressure scores began to climb again. By the end of the feeding period, just a month before the animals were due to go to slaughter, their pulmonary arterial pressures were higher at 4,000 feet in the late feeding period than they were at 7,000 feet when they were 6 months old.

"We also did epidemiological studies of 15 feedlots in western Canada and the U.S., and these studies also show cattle that die of heart failure typically do so during the feeding period, even in low elevations. This so-called high altitude disease was occurring at altitudes around 1,500 feet. What was once called high altitude disease is more widespread than originally thought," Neary says. Currently, he has a graduate student who is analyzing some blood samples provided from a low-elevation feedlot in Nebraska.

In the past several decades producers have selected cattle that grow fast, put on weight quickly and produce bigger carcasses without selecting for athletic ability and adequate lungs. "If you look at bison or other bovines, they have a deep chest and are narrow toward the flanks. We want beef cattle to have a big belly to take in lots of feed [less room for heart and lungs], and they don't need to run away from predators. There is no selective pressure on cattle to have adequate lung capacity. There are always some adverse consequences to selective breeding for certain desired traits and we don't always know what those consequences are," Neary explains.

Beef producers today also tend to select for calves that are born small and grow large. Heather Foxworthy, CSU Department of Animal Science graduate research assistant, recently completed research looking at the correlation between gestation length, calves born small and high elevation disease, or BCHF. Since lung development occurs in utero, some scientists wonder if gestation length is a source of variation in PAP scores and a predictor of an animal's susceptibility to high altitude disease later in life.

The objective of Foxworthy's study was to determine the relationship between gestation length and PAP in Angus cattle at high elevation. The PAP and gestation length observations were obtained from CSU's Beef Improvement Center in Wyoming, using breeding and calving records from 1,991 calves from 2007 to 2016. Gestation length was calculated and verified with ultrasound up to 50 days after artificial insemination and subsequent calving records. The data included PAP measurements, gestation lengths, age of dam, birth year and calf sex at birth. Final results showed no effect of gestation length or age of dam on yearling PAP score, while birth year and sex of the calf did have an effect. This study concluded that gestational age at birth should not increase an animal's susceptibility to developing high altitude disease.

Geneticists have been trying to discover if there is a specific genomic region of DNA that serves as a genetic risk factor for BCHF. If a defective bit of DNA exists and can be identified, it may be possible to do genetic testing and to select cattle that do not have it. It will take time, however, before producers have the genetic tools to be able to have some impact in terms of breeding this problem out of the cattle.

In the short term, producers need some strategies to be able to manage BCHF, since in the early stages it is very difficult to tell if these are cases of respiratory disease or heart failure. Even though feedlot cowboys may suspect a certain animal will turn out to be a heart failure case, they cannot risk not treating it for a respiratory disease. Yet if they treat with an antimicrobial drug, there is a withdrawal period before that animal can be slaughtered. Since heart failure is terminal, the only thing that can be done is slaughter for salvage before that animal goes too downhill. However, if the animal is treated for respiratory disease, it may die before the withdrawal period is over.

Researchers are hoping to be able to provide the feedlot veterinarian or producer with a tool for early diagnosis. Then, when the feedyard has a suspect case, the staff can quickly determine whether the affected animal is indeed a heart failure case and can get the animal to slaughter while it still has some value, rather than just treating it with antibiotics.

Ideally, researchers may eventually find some biomarkers or other genetic tools that will allow the industry to selectively breed away from this — and have a smaller percentage of animals at high risk for becoming fatal cases. If there is an underlying risk factor that is complicated by rapid growth and if at-risk animals can be identified, those animals could be managed in a different way — perhaps on a less energy-dense diet for slower growth. Researchers are still a long way from this goal, but future research holds promise at finding ways to alleviate ongoing frustration and losses. HW

Editor's note: Heather Smith Thomas is a freelance writer, author and rancher from Salmon, Idaho.