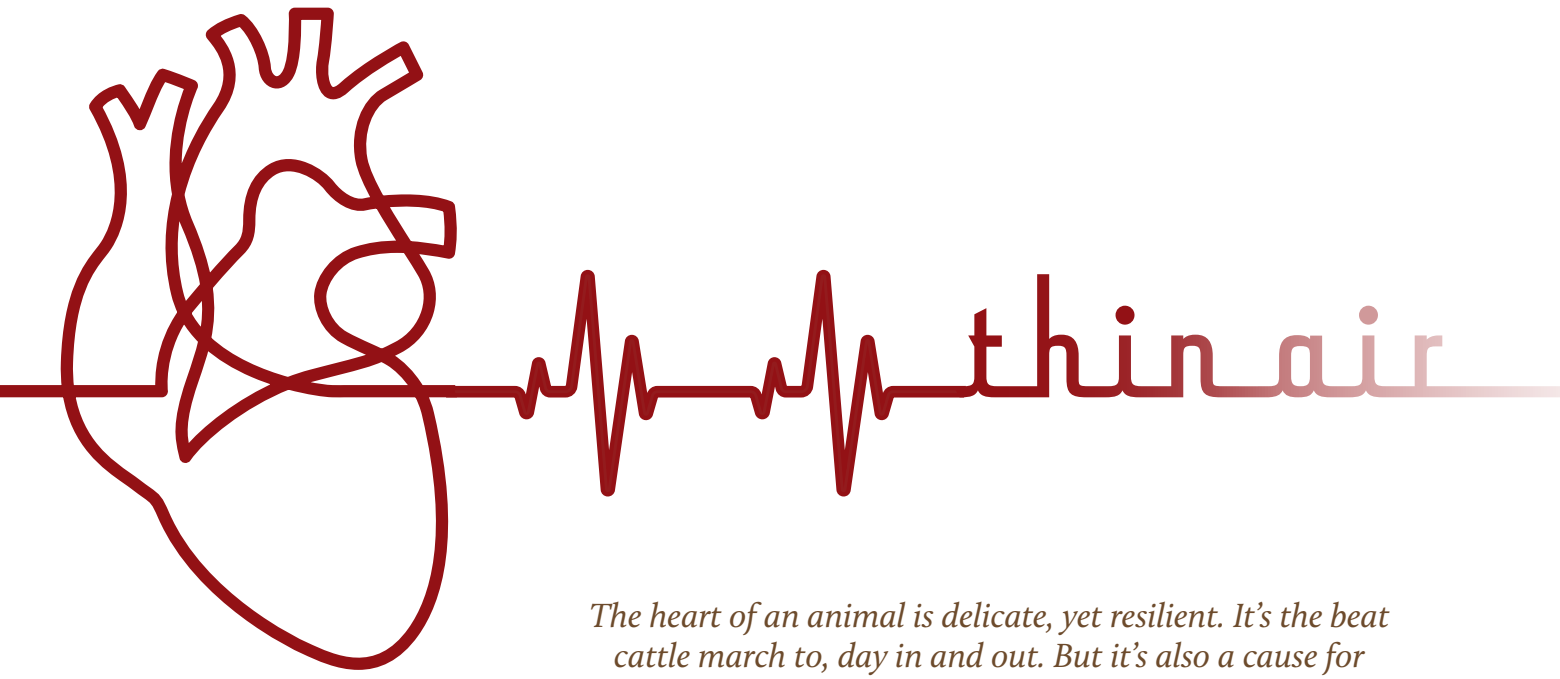

The heart of an animal is delicate, yet resilient. It's the beat cattle march to, day in and out. But it's also a cause for concern in high country, maybe even not-so-high country in modern beef cattle production.

by Lindsay King, assistant editor

It has many names – high altitude disease (HAD), bovine high mountain disease (BHMD), brisket disease and high-altitude pulmonary hypertension — just to name a few. Though the kicker isn't the name, it is cattle's susceptibility to increasing blood flow resistance at various altitudes putting the furrow in a rancher's brow.

"High altitude disease is caused by a lack of oxygen resulting in overworking and remodeling of the heart in an animal," says Hannah Garrett, Neogen territory manager based out of Wyoming. "Since the heart is a muscle, when it has to work harder to get blood to the lungs to be oxygenated, it can cause changes to the structure and function."

Physiology of less air

As the heart is working harder to get blood to the lungs, the artery walls thicken from the extra effort. This obstructs the already low oxygenated blood flow, making the veins smaller and more difficult to pump through.

HAD is defined by Jann Rhodes in the *Journal of Applied Physiology* as, "A progressive increase in arterial vasoconstriction due, in part, to vascular smooth muscle hypertrophy and relatively fixed obstruction of the pulmonary arteries."

Eventually an animal suffering from HAD will succumb to the symptoms of the disease, primarily driven by a lack of oxygen. This is the simple physiological result of a complex disease usually associated with death in cattle at high elevations.

Low oxygen availability is stressful on the heart, and ultimately changes the way blood flows. Though the pulmonary hypertension impacts the right ventricle the most.

As blood backs up into the heart from decreased function, the fluid has few places to go. This fluid accumulation can lead to ventral edema causing swelling in the brisket area, a telltale sign of right heart failure.

Generally, this swelling is the most obvious physical informant of HAD and the reasoning behind the name brisket disease.

"Since there are multiple physiological systems involved, it can be hard to pinpoint the exact cause of this disease," Garrett says. "There are plenty of

other illnesses with similar symptoms, adding to the difficulty of identifying clinically affected animals."

Most symptoms will show up once exposed to higher elevations, which has been cited as 4,500 feet or higher. These cattle are often lethargic, short of breath and weak. These symptoms, unfortunately, explain many other cattle ailments.

Just give it a PAP

Making leaps and bounds for high-altitude producers is Colorado State University's (CSU). Tim Holt, associate professor of clinical sciences in the College of Veterinary Medicine and Biomedical Sciences. Though not his entire focus, his research into HAD and pulmonary arterial pressure (PAP) testing is instrumental to evading disaster for the mountain men of the cattle industry.

PAP testing can identify high-risk cattle for HAD. Using a three-inch, 12-gauge needle allows a catheter to flow into the right pulmonary artery.

"The procedure is similar to cardiac catherization in people," says Ben Abbey, Dillon, Mont., veterinarian trained by Holt for PAP testing. "The catheter is connected to a pressure transducer to measure PAP, which is derived from the mean of the systolic and diastolic pressure."

Abbey moves the needle into the right jugular vein and feeds the catheter back through the right atrium and ventricle to hit the pulmonary artery. His expert hands make the less than five-minute procedure appear effortless as he watches the transducer for the PAP score.

"The stress of the test itself can increase the systolic pressure but this tends to make the diastolic pressure decrease so the overall score is still accurate," Abbey says.

The highest level of accuracy is achieved when the test is performed at the elevation the animal is expected to survive and thrive at. As the animal ages, their PAP score will increase. This makes it crucial for the test to occur after the animal is at least 12 months old. It should be noted that animals need to be at the test location for at least three weeks before a catheter, for the test, is ever inserted.

"This test has high repeatability at elevations of 5,500 to 7,500 feet but you also have to consider

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the age of the animal," Abbey explains of how most animals reach sexual maturity at 12 months old and should not be tested any earlier. "When tested at the proper elevation, we usually have between 75% and 95% repeatability."

The average cost of a PAP test is under $30 per animal, plus the farm call charge. With cooperative cattle and an expert hand like Abbey's, a PAP test is a quick way to save producers a lot of trouble.

With such a small number of veterinarians trained for PAP testing, it only makes sense that a majority of them were under the tutelage of Holt at one time or another.

"There are only about six vets doing the test right now," Abbey says and notes that other people have been trained to conduct the test that are not licensed veterinarians. "Though the test has to be done precisely to be accurate."

Does it come out of thin air?

A 2007 study conducted by CSU researchers, including Holt, found the heritability of a PAP score to be 0.34, respectively. Any trait marked above 0.30, is moderately to highly heritable.

It has been speculated HAD can be a result of poor nutrition, a genetic condition or simply a disease. As feedlot cattle in Nebraska, Louisiana and Kansas die from congestive heart failure that mimic HAD symptoms, researchers turn to the double helix for clear answers about the real cause.

"It doesn't appear to be a point mutation, protein or single nucleotide polymorphism (SNP), it appears to be polygenic (controlled by several genes)," Garrett says, but also reminds producers an animal is a product of its genotype and environment.

When producers send animals to graze in the mountains, some just don't ever come back.

No one breed of beef cattle has proven to be a carrier of susceptibility to this disease, though some are just better suited for higher elevations from the get go.

"The best way to manage risk is to use proven bloodlines, purchase PAP-tested bulls, PAP-tested females and immediately haul at-risk animals to lower elevations," Garrett says.

Though it is rare for a rancher to observe an animal suffering from HAD before it is too late.

"Since only 2% of cattle producers live at or above 6,500 feet, it is hard to get financial backing to further investigate this issue," Garrett says of the challenges HAD presents producers.

She refers to a study conducted by Joseph Neary, Texas Tech University, from 2000 to 2012, where 15 feedlots evaluated the economic impact of death due to right heart failure.

"The epidemiologic study of north American feedlots involved 1.56 million cattle where the occurrence of death by congestive heart failure doubled," she adds.

Though it is still unclear if the deaths in feedlots and at high elevations are connected, the symptoms and necropsy results are unnervingly similar.

"A lot of things we see in brisket disease is mostly genetic, type one diabetes," Abbey says. "What we have been seeing in feedlots has more to do with what we call type 2 diabetes in people."

As cattle put on their final pounds for market, their body mass continuously increases while their heart remains the same size. Just as reduced oxygen levels cause the heart to work harder, so does packing on the pounds.

"This obesity type of heart disease can have an effect on oxygen hypoxia," he adds. "But something we should consider of the cattle we believe to have low PAP scores is there could be subclinical signs of this disease on their overall performance on the rail."

Even the low PAP scores aren't a guarantee. Some say that's just how the cattle business works. Others know better as technology rapidly finds a way to avert the crisis known as HAD. AJ

Research PAP EPD by Angus GS

The National Western Stock Show (NWSS) will be the tentative site for the release of the latest expected progeny difference (EPD) from Angus Genetics Inc. (AGI).

"We are getting a collection of data from our members, partners at Colorado State University (CSU) and Dr. Holt to develop an EPD for pulmonary arterial pressure (PAP)," says Kelli Retallick, AGI director of genetic service.

Though a genetic tool will be available to identify cattle more susceptible to high altitude disease (HAD), Retallick warns producers that it will not replace PAP testing each individual animal.

"It isn't like our weaning weight EPD, if we send a calf that does not PAP well up to high altitude it is now a life or death situation," Retallick says. "This is probably one of the most important traits that we need to think about from a phenotypic standpoint."

With the development of a PAP EPD, the AGI team has started to explore the potential relationship between a high elevation and feedlot deaths. Unfortunately, the clear answers aren't there to confirm anything in that relationship. As always, more research is the next step for improved accuracy for either conclusion.

"PAP testing is phenotypic data that validates the genomic data. We cannot find informative SNP (single nucleotide polymorphism) markers without the physical data," Retallick says. "Genetecists have identified some markers possibly linked to the disease but they have not been validated yet."

As more PAP data comes in, it can be coupled with an analysis to do a genome scan. This will lead to more definitive answers about the cause for HAD susceptibility.