Danger at 5,000 Feet

High-altitude disease (HAD) symptoms are directly related to congestive heart failure, including edema in the brisket and lower body, a fluid-filled abdomen and chest, diarrhea, bulging eyes, depression, and (most of all) weakness. [PHOTO COURTESY OF TIM HOLT]

Story by
COLETTE KNUTSON GJERMUNDSON

Just as the level of athletic ability, training and concentration mean gold or groans for an Olympic athlete, genetics, environment and stress can mean a productive life or weakness and death for cattle in high altitudes.

High-altitude disease (HAD) — also known as brisket or high-mountain disease, dropsy, or big brisket — affects cattle living 5,000 or more feet above sea level. It is characterized by pulmonary arterial hypertrophy and pulmonary hypertension resulting in congestive heart failure.

In other words, chronic low-oxygen tension causes the small pulmonary arteries to thicken, resulting in high blood pressure and a weakened heart, which prevents the heart from circulating blood sufficiently. This leads to blood congestion in the heart and, if untreated, results in death.

A backward glance

Veterinarian Tim Holt, Town and Country Animal Hospital, Gunnison, Colo., and Jim Brinks, Colorado State University (CSU), Fort Collins, were first approached about HAD about 20 years ago when participants in the Wyoming Angus bull test and the CSU bull test in Hesperus, Colo., requested pulmonary arterial pressure (PAP) scores on their bulls.

"At first we thought we had something new," Holt says. "But when we looked at literature and talked to ranchers, we realized it had been around for a long time."

History reveals that Spanish conquistadors observed the condition in their cattle during 16th-century South American expeditions. Brinks says it became a recognized problem in the Colorado Rockies during the late 19th century, and the first publication regarding HAD was printed in 1912 by Glover and Newson of CSU. Though long associated with high altitude, the relationship and resulting pulmonary hypertension were not proven until the late 1950s.

Holt — a hands-down gold medalist in PAP testing, having performed 85,000 tests since 1980 — says cattle in Colorado, Wyoming, Utah and New Mexico are most affected. "The place we really see it is at 6,800 feet and above," he says, noting that the problem progresses as elevation rises.

Symptoms, factors

HAD symptoms are directly related to congestive heart failure, including edema in the brisket and lower body, a fluid-filled abdomen and chest, diarrhea, bulging eyes, depression, and (most of all) weakness. Lesser degrees of the disease manifest as reproductive failure, abortion and calving loss.

"Because the calves simply die, a lot of people aren't diagnosing neonatal calf loss due to HAD," Holt notes. Most HAD deaths occur between birth and weaning because cattle face the most life stresses during that period.

Though all animals experience some low-oxygen tension and elevated pulmonary blood pressure in high altitudes, the lobulated lung and small lung size in relation to body weight make the restriction more severe in cattle. Research indicates that dogs, sheep, llamas and yaks are more resistant to HAD.

Factors contributing to HAD include respiratory diseases, pneumonia, lungworm, chronic cold temperatures of less than 10° F and genetic heritability. Genetically susceptible cattle are more prone to develop HAD in the presence of the other factors. Some cattle appear to be more naturally resistant, while others rapidly develop the pathological changes and die of HAD within a week of high-altitude exposure.

It's important to note that some poisonous plants mimic high-altitude disease by damaging the heart muscle. "That is a whole different pathogenesis, a whole different story," Holt says. "But animals with high-altitude disease die of heart failure, so anything affecting the heart may show the same clinical signs."

*"We're looking for [PAP] scores in the mid-30s to 40," says veterinarian **Tim Holt**, Gunnison, Colo. "We get concerned with scores of 45 and up. I've seen numerous animals die of high-altitude disease after scoring 49 or 50." [PHOTO BY WES ISHMAEL]*

*Tybar Manager **Mark Nieslanik** (right) says, "**David** (**Danciger**, left) was planning for next year's mating before we finished AIing this year. No one else would have taken the time to accumulate the information we have. It takes a lot of effort and money to have them all PAP tested." [PHOTO BY COLETTE KNUTSON GJERMUNDSON]*

Heritability

PAP testing was developed in the late 1960s and measures pulmonary hypertension, or blood-flow resistance, to predict an animal's welfare at high altitudes. PAP scores, an average of diastolic and systolic blood pressures, are measured in millimeters of mercury (mmHg) and generally range from the mid-30s to 130; but Holt has measured scores from 29 to 210 mmHg.

"We're looking for scores in the mid-30s to 40," he says. "We get concerned with scores of 45 and up. I've seen numerous animals die of high-altitude disease after scoring 49 or 50."

PAP testing also predicts which animals are HAD susceptible. This provides a means to select breeding cattle that are more resistant to HAD, thereby minimizing economic loss at high altitudes.

PAP testing paternal half-siblings has proven that the condition is highly heritable, about 69%. "Therefore, a high-testing bull's offspring has the potential to carry or develop HAD," Holt says, noting that heritability has been shown to be up to 80%.

Brinks notes, "It's very difficult to track heritability because PAP scores are affected by genetics, environmental stresses and possibly high levels of nutrition."

Holt adds, "If a young calf gets pneumonia, it makes the PAP test hard to evaluate" because it's difficult to differentiate between genetic heritability and environmental factors.

Most PAP tests are performed on Angus and Red Angus cattle. "There is a problem in those breeds," Holt says, "but there's a problem in every breed." Some breeds may have less natural resistance to HAD for reasons that are yet unproven.

It is traditionally thought that females are less likely to die of HAD than males, but Holt says, "It used to be that females were turned out and never produced under the pressures a male was, at least on a large scale. Now heifers are put in feedlots and development programs. They're virtually raised the same, so you can't separate males vs. females anymore."

PAP testing at the Tybar

Texas natives David and Emma Danciger began ranching south of Dallas, Texas, in 1950. They built a herd of 350 registered Angus cattle, operating until 1964. In 1980 they purchased the Tybar Ranch southeast of Carbondale, Colo., and began managing Angus cattle on scenic, irrigated land at 6,500 feet.

They purchased 60 foundation females from Bill and Minnie Lou Bradley, Memphis, Texas. Today, the Tybar is home to 250 registered and PAP-tested Angus cattle. They added another ranch at Rifle, Colo., in 1993.

The Dancigers' first run-in with HAD came in 1984 when they noticed an increase in yearling cattle deaths on their Bureau of Land Management (BLM) and U.S. Forest Service (USFS) summer permits.

They soon learned of HAD, and CSU professor Robert Teagarden told the Dancigers that PAP testing was one way to combat it. Their entire herd was tested in April 1984, and new cattle were scored in subsequent years, all with the intent of gathering data to control or to eliminate the genetic condition and to produce cattle with low PAP scores.

"After a few years of trying to use PAP scores to make breeding decisions, it became obvious that knowledgeable help was needed, especially in evaluating sires," David Danciger says. That help came from Brinks and Mark Enns, a graduate student at the time. "CSU has helped us enormously in our efforts to conquer brisket disease," he adds.

Since 1984 the Tybar has PAP tested nearly every animal produced or used on the ranch, so almost every animal with the Tybar name has a PAP score. Danciger now has more than 2,000 PAP scores in a valued computer database he developed himself. "I can average our herd PAP scores if I want to," he says, as he pushes keys and a 40 appears on the screen.

Danciger's office is filled from ceiling to floor with binders full of cattle data, so it's obvious that testing all bulls and females takes a lot of calculating and paperwork. But he believes it's worth the effort. "It's what you have to have," he says. "That gives us the complete picture. People who are losing cattle big-time are looking for relief."

Tybar Manager Mark Nieslanik says, "David was planning for next year's mating before we finished AIing (artificially inseminating) this year. No one else would have taken the time to accumulate the information we have. It takes a lot of effort and money to have them all PAP tested."

While some fellow producers see the Tybar as fortunate to operate at 6,500 feet where PAP testing is more convenient, Nieslanik counters by saying, "We see it as a hindrance. We have to produce the very best seedstock we can and deal with brisket disease on top of it. It's fun, but it's also frustrating."

Managing HAD

People at the Tybar want their PAP scores to be less than 40 mmHg. "Below 38 is even better," Nieslanik says. They will not use any bull with a PAP score of 46 or higher. "There are bulls we'd really like to use, but we can't because they'll probably give us problems in the PAP area," he adds.

Brinks says in managing high-elevation cattle, PAP scores should take precedence over every other characteristic. However, selections for carcass and growth traits still can be made. Danciger recognizes that, and his selection process starts with the sire and dam pedigrees and PAP scores.

"I can't just concentrate on PAP scores and let everything else go," he says. In addition, the Tybar concentrates on birth weight EPDs of 3 or less, EPDs of about 30 for weaning, 50-70 on yearling weight and as much marbling as possible.

Paying close attention to genetic selection means Tybar's PAP scores improve annually. Still, the process and progress is slow. Nieslanik says, "We've been doing it for 15 years, and we're just now seeing results."

A pen of 25 steer calves from the Tybar were fed in the CSU Ranch-to-Rail Program at Horten Feedyards, Greeley, Colo., in 1996. "The results of our work really came together when those cattle were fed out and slaughtered," Nieslanik

says. The steers had a 3.06-pound (lb.) average daily gain (ADG), a 12.4-square-inch ribeye area (REA) and no feedlot deaths.

"Feedlot operators have told us for years that sudden feedlot death can be attributed to brisket disease," Danciger says. There is believed to be a connection between nutrition and HAD, but Holt notes the relationship and degree of effect is not clear.

Noting their overall incidence of HAD, Danciger says, "We've lost very few animals. In the mid-1980s we had a couple of steers with really high PAP scores — about 100 — so we thought we'd feed them out and eat them right here. When they were just about ready for the slaughterhouse, they died."

HAD is best controlled genetically, but it can be treated by moving affected cattle to a low altitude and treating them with antibiotics, vitamin B-complex and a diuretic. Holt says, "I go to the extent of draining the tremendous amount of fluid that gathers in their chest cavity."

PAP-based marketing

Because a sire must be kept at an altitude above 5,000 feet for three to four weeks to record an accurate PAP score, only a few AI sires have been PAP tested. Though the industry is making progress in many areas, Holt says, "The number of AI sires tested for HAD just isn't there."

Danciger notes, "We have produced 10 AI sires and are the only breeders marketing semen from PAP-tested AI sires."

The Tybar Ranch is among the few operations that market PAP-tested females bred to produce calves that, if kept healthy, will have low PAP scores. The ranch hosted its first production field day Nov. 4, selling 70 registered, PAP-tested females.

Among the Tybar's satisfied customers are Carl and Wilma Martello, Salida, Colo. The Martellos have a commercial herd in the heart of the Rockies and have used Tybar bulls for about five years.

Turning to Tybar bulls to add thickness, Carl Martello says, "We've had really good results with them and no trouble with high-altitude disease. We can trust the PAP score, and the composition is real good. … We're at 8,000 feet, and we haven't had an ounce of trouble yet."

Just as athletic ability, intense training and steadfast concentration could mean gold to some athletes in the upcoming Winter Olympics, PAP-resistant genetics mean productive lives for cattle in high altitudes.

INSIGHT:

How is a PAP test performed?

To obtain a pulmonary arterial pressure (PAP) score, an animal is secured in a squeeze chute and haltered. Its head is pulled to one side, and a 13-gauge, 3.5-inch needle is inserted into its jugular vein. A catheter filled with saline is inserted into the jugular vein and hooked to a datascope to measure pressure and to monitor waves. The catheter is pushed down the jugular vein, through numerous sections of the heart and into the pulmonary artery.

"The pressure generated in the pulmonary artery tells me if that animal is experiencing high blood pressure on the pulmonary side of the heart and if it is a possible genetic carrier of HAD (high-altitude disease)," says veterinarian Tim Holt, Gunnison, Colo. Average test time is three to five minutes per animal, and cost ranges from $10 to $17.50/test.

When evaluating a PAP score, there are several factors to consider.

Age of animal. *Retesting specific animals over the past 10 years has determined that a PAP score is less accurate in animals tested at 12 months or younger. Holt says PAP scores of 30-35 millimeters of mercury (mmHg) at less than 12 months of age are approximately 90% accurate, while PAP scores of 35-40 are approximately 82% accurate.*

Any score greater than 41 indicates an animal's ability to resist HAD is uncertain and may change as the animal ages. Holt strongly recommends that these animals be retested. Scores greater than 49 are highly accurate, regardless of the animal's age or the altitude, and such animals are a high risk for high-altitude problems.

Elevation of test. *Because PAP scores measure lung resistance and a thickening of the lung vessels brought about by chronic exposure to low oxygen, testing elevation is important. An animal must experience low oxygen at 5,000 feet or higher for at least three weeks to obtain an accurate score.*

Also, the higher the test-site elevation, the more accurate the test. The PAP score can be expected to increase approximately 1-1.5 mmHg per 990 feet in increased elevation if the initial test was taken at 7,128 feet or higher; but not all cattle follow this generalization, especially if testing is conducted at the absolute minimum of 5,000 feet. At that level the degree of variability is unpredictable, and retesting is recommended.

Breed. *After testing 85,000 head during the last 20 years, Holt says animals with high PAP scores (greater that 50 mmHg) have been found in all breeds tested. However, some breeds and some pedigrees within breeds seem to be more naturally resistant to HAD.*

He notes that any animal originating from a lowland herd has a greater probability of experiencing high-altitude effects than does an animal raised in higher elevations, probably due to long-term natural selection.

Illness and vaccination. *Since a PAP score measures lung blood-flow resistance, any respiratory or pulmonary disease can increase the PAP score. If a high PAP score is thought to be secondary to a temporary pulmonary disease, the animal should be retested. However, Holt notes that PAP scores greater than 50 mmHg are not known to drop to an acceptable level. "It appears that once the PAP score is this high, extensive pulmonary vascular damage has occurred, and the animal remains a high-risk candidate for HAD," he says.*

Table 1: PAP score evaluations

PAP score, mmHg	Evaluation
30-35	An excellent and highly reliable score
36-40	An excellent score for any animal older than 12 months. For a younger animal, the score is fairly reliable; but retesting is suggested.
< 41	Reliable score in all animals older than 12 months. It is recommended that yearling cattle score less than 41, depending on testing altitude.
41-45	An acceptable score for animals older than 6 months. Younger animals should be retested.
45-48	An acceptable score for animals older than 6 months that have been in high elevations for an extended period. These animals should be considered at some risk. Testing altitude and animal's location should be considered.
>49	Animals in this range are considered at high risk for themselves and their offspring. Many animals scoring in this range have died of HAD.

NOTE: These figures from veterinarian Tim Holt, Town and Country Animal Hospital, Gunnison, Colo., are based on cattle 12 months old or older and tested at or above 6,500 feet. If an animal does not meet these criteria, adjustments must be made as noted in the "Elevation of test" section above.