

High Mountain Disease in Cattle

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High mountain disease (HMD) is also known as brisket disease, high altitude disease, dropsy or big brisket to the rancher and is a common condition in cattle raised on ranches at high altitudes (>5,000ft) in Colorado and its surrounding states. Although the proportion of oxygen in the air is the same at all altitudes, the atmospheric pressure is not. This means that as altitude increases the oxygen content in the air decreases. The reduced amount of oxygen present in the air at high altitude means less oxygen reaches the lungs and pulmonary artery. This causes the pulmonary artery to constrict, becoming narrower, making it harder for the heart to pump the same amount of blood through the lungs (similar to a partially blocked hose pipe). The constrictive response of the pulmonary blood vessels to low oxygen levels common to all mammals is a means of distributing blood away from poorly oxygenated areas within the lung to areas that are better oxygenated. However, there are three main reasons why cattle are particularly susceptible to low oxygen levels:

- i. The contractive shunting response in cattle is more exaggerated than other species.
- ii. The design of the bovine lung does not allow free passage of air between neighboring regions.
- iii. Cattle have small lung-size to body-weight ratios.

The result of pulmonary artery contraction and narrowing is increased blood pressure in this vessel (pulmonary arterial hypertension). If the animal stays at high altitude and the hypoxic stimulus remains then the muscle cells present in the wall of the pulmonary artery grow so that the wall thickens. Eventually, due to the sustained pulmonary arterial hypertension, right-sided congestive/dilatory heart failure develops. In order to pump the same amount of blood through the lungs the heart must work harder. Similar to muscle growth from resistance training or enlargement of the heart by endurance training in humans the heart of cattle with elevated PAP responds to the increased workload by enlarging. However, over time, the changes that occur within the heart reduce the effectiveness of the heart as a pump and the heart begins to fail. Heart failure produces the clinical signs characteristic of the disease, and ultimately leads to death of the animal.

The signs of HMD

The cardinal sign of HMD is swelling of the brisket due to the buildup of fluid (edema). Other signs apparent of HMD in a live animal may include:

- Lethargy
- Weakness, unable to rise
- Decreased appetite
- Collapse
- Diarrhea
- Bulging eyes
- Distension and pulsation of the jugular vein

- Swelling due to edema of the limbs, under the jaw and/or belly
- Edema of the brisket region most apparent
- Death

The body temperature is usually normal but it may rise if there is an underlying illness or the animal is heat stressed.



High mountain disease in a calf.



The heart responds to the increased demand placed on it by the high PAP by enlarging through cell replication. However, when dilation of the heart chambers exceeds wall thickening the function of the heart deteriorates for a number of reasons such as poor contractility and relaxation and increased wall stiffness. Ultimately, heart cells begin to die as the heart fails.



Brisket edema in a steer that died from HMD. Clear edema fluid oozes from the incision. The skin over the brisket pits when pressed with a finger.

Treatment

Pulmonary arterial pressure (PAP) testing can be used to detect pulmonary arterial hypertension. However, drugs cannot cure or prevent death from this disease. Preventative measures must be taken if HMD is to be avoided in other animals in the future.

It is important that HMD is differentiated from other causes of right side congestive heart failure because the measures that need to be taken to prevent future cases can be very different depending on the cause. For example, other causes of right-sided heart failure may include traumatic reticulopericarditis (hardware disease) due to consumption of wires or other metal foreign bodies, viral or bacterial infection of the heart and cardiomyopathy (degeneration of the heart) due to nutritional or hereditary reasons within the herd.

Prevention

PAP measurement requires insertion of a large bore needle into the jugular vein through which a long flexible catheter is passed. The catheter is gently fed through the needle, down the jugular vein, through both the right atrium and then the right ventricle into the pulmonary artery. A pressure transducer attached to the catheter measures the pulmonary arterial pressure.

A high PAP measurement (>49 mmHg), regardless of age or altitude of the test, is a very accurate predictor of a high PAP measurement later in life. Therefore, one can assume that such an animal has a high likelihood of developing HMD if kept at high altitude.

Risk factors for PAP

Breed

It is thought that some breeds and specific pedigrees within breeds may be more naturally resistant to the effects of high altitude. However, all breeds show evidence of HMD.

Gender

There is no underlying physiologic basis for a difference in PAP between males and females. However, differing management and feeding practices may result in different PAP measurements for males and females in certain herds.

Pregnancy

Pregnant cattle usually have a higher PAP measurement than non-pregnant cattle. The increase in the PAP score is higher for animals that already have a high PAP before pregnancy.

Age

Eighty percent of animals tested at less than 12 months that have a PAP between 30 and 40 mmHg will remain at acceptable PAP levels at that particular altitude as they mature. Animals less than 12 months old with high PAP are accurately predicted to have high PAP later in life. However, mature PAP measurements for young animals that initially test between 41 to 49 mmHg have a high variability.

Other concurrent disease

Any cause of pulmonary hypoxia can increase PAP measurement; temporary or permanent. This may include infectious respiratory disease viruses, bacteria such as *Mannheimia hemolytica*, parasites such as lungworm and noninfectious causes such as traumatic reticuloperitonitis (hardware disease). Although respiratory disease alone may cause increased PAP, animals at high altitude are particularly susceptible.

Environment conditions

Temperatures below freezing have been shown to increase PAP by 25% to 55%. Locoweed contains swainsonine that when ingested (certain species of *Astragalus* and *Oxytropis*) increases the incidence and severity of HMD in calves at high altitude but there is no evidence suggesting any affect on PAP. It is possible that swainsonine is directly toxic to the heart.

Genetics

The susceptibility of cattle to hypoxia-induced pulmonary hypertension is inherited. The genetics of susceptibility are currently being investigated.

Nutrition

Ionophores fed to cattle at high altitude may increase the risk of pulmonary hypertension.