Grass Tetany in Cattle – An Examination of its Causes, Clinical Signs and Cures

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Introduction

Grazing animals on pasture can be an integral part of an effective feeding regime for cattle and other livestock. Grazing reduces valuable labor time and cost for the farmer because no harvesting is needed and provides exercise for the animal; however, as with other feeding programs, it does not come without risk.

A concern when livestock are allowed to graze on pasture is grass tetany. Grass tetany is typically found in ruminant animals, with lactating cows being the most susceptible (Allison, 2003). Grass tetany generally becomes a problem when the diets of cattle are changed from winter stockpiles (silages) to rapidly growing, lush, spring grasses (Caley, 2003). Testing may indicate high levels of potassium (K) and nitrogen (N) and low levels of magnesium (Mg), calcium (Ca), and sodium (Na) in the soil (Elliot, 2007). Incidences of grass tetany are seasonal and more common when the weather is cool and rainy. Pastures prone to cause grass tetany include, but are not limited to, a wide variety of warm season grasses such as orchardgrass, perennial ryegrass, tall fescue, timothy, and bromegrass. When grazed, small grains such as wheat, barley, oats, and rye can also cause grass tetany. Lastly, grass tetany can occur in livestock that are wintered on low Mg grass hay or corn stovers (Allison, 2003).

Etiology

It is hypothesized that grass tetany (also called hypomagnesaemia tetany, lactation tetany, grass staggers, winter tetany, or wheat pasture poisoning) is caused by a deficiency of Mg in the blood; however, not all animals with hypomagnesaemia will develop grass tetany (Harris and Shearer, 2003). Normal levels of Mg in the blood are about 2 mg/100 ml of plasma. In a hypomagnesaemic animal, the level of Mg in the blood is reduced to 1 mg/100 ml. In an animal with grass tetany, a level of blood Mg will likely be below 1 mg/100 ml (Allison, 2003).

The decrease of Mg in the blood when cattle are grazed on pasture can be attributed to low concentrations of Mg (<0.2 % DM) in the forage. While affected forages are low in Mg, they are often high in potassium (>3.0 % DM) and N (>4.0 % DM; Allison, 2003). A "tetany ratio" can be used to calculate whether or not forage is at risk for causing grass tetany. It is calculated on an equivalent weight basis and accounts for the molecular weight of each element rather than the percentage or ppm. It is as follows, (% DM of K ÷ 39) ÷ (% DM of Ca ÷ 20) + (% DM of Mg ÷ 12.1). A value of 2.2 or greater classifies the forage as being "tetany-prone" (Filley, 2005).

Cows in transition and up to 2 months post-calving are the most susceptible to grass tetany. This is due to their need for excess minerals because of those that are lost through milk production (Filley, 2005). For example, ten liters of milk contains approximately 1.2 g of Mg (Elliot, 2007). All animals require Mg in their blood. It functions as a cofactor to enzymes with the most important being ATP kinase, which is required for cellular function (Berger, 2006).

Cows require a constant supply of magnesium in their diets. There is only a small amount of Mg that is stored in the body and its absorption is partially dependant on the concentration of phosphorus (P) absorbed through the rumen (Elliot, 2007). Not all of the Mg fed to cows is absorbed and lactating cows should be fed a minimum of 13 to 15 g/head/d to prevent Mg deficiency (Allison, 2003). When cows graze pastures low in P, Mg absorption through the rumen is limited (Elliot, 2007). Also, it has been found that when there were adequate levels of P in the soil, more Mg was utilized by the plant (Caley, 1991).

Clinical Signs

Incidences of grass tetany can be characterized as acute, sub acute, or chronic. In acute cases, the animals are generally found dead. If the animal is discovered alive, clinical signs may include excitability, twitching, ear flicking, aggressiveness, abnormal gait, vocalization, convulsions, and frothing at the mouth. Their body temperature begins to rise and their heart beats louder and faster. Death generally occurs within 1 h of the onset of symptoms. In sub acute cases, animals remain standing and signs develop over a period of a few days and include abnormal gait, excessive blinking, decreased feed intake, weight loss, and decreased milk production. The sub acute form, if not treated, can also result in death. Lastly, in the chronic form of grass tetany, animals may exhibit unthriftiness, weight loss, and decreased milk production (Cronin, 2006).

Diagnosing Grass Tetany

The diagnosis of grass tetany is difficult because the cow usually dies before any determination can be made. Immediately before clinical signs are seen, serum Mg levels will be low. As symptoms progress, serum Mg levels may rise to near normal levels. A better diagnostic method is the measurement of urinary Mg because the kidneys will begin storing magnesium when serum Mg levels become insufficient (Allison, 2003). Grass tetany is sometimes mistaken for other metabolic disorders in cattle. Because of its symptoms, hypomagnesaemia can be misdiagnosed as ketosis or milk fever; however, animals that are deficient in Ca will generally appear sluggish, whereas Mg deficient animals will exhibit excitability (Chambliss and Kunkle, 2003).

Treatment Options

Treatment of grass tetany involves removal from the pasture and increasing blood serum levels of Mg. A treatment method that has been suggested by the USDA is a dose of 200 ml of a 50 % solution of magnesium sulfate, injected subcutaneously. The injection will increase the level of Mg in the blood rapidly in only 15 minutes. Another method is an intravenous injection of calcium-magnesium gluconate; however, it is recommended that an injection of chloral hydrate or magnesium sulfate be given intravenously prior to treatment to calm the animal. Intravenous injections of these solutions must be given slowly to prevent cardiac arrest. Heart and respiratory rates should be monitored closely during treatment. After serum Mg levels are increased, the animal should be continued on a diet high in Mg to prevent relapse (Harris and Shearer, 2003).

Some factors may predispose cattle to developing grass tetany. They include the age of the cow, breed, amount of milk being produced, time of calving, and stress. As cows age, the level of Mg and other minerals that are absorbed through the rumen are decreased. In addition to age, researchers have determined that Angus and Angus crosses are more susceptible then other breeds because they are naturally poor absorbers of Mg. Also, because minerals and nutrients are removed through the production of milk, high producers are susceptible to hypomagnesaemia and grass tetany. In addition, the time in which cows calve is important because grass tetany generally occurs in the early spring months. If a cow is placed on pasture during this time and has recently calved, it places the cow (and calf if she is nursing) at greater risk. Lastly, stress (both environmental and physiological) predisposes animals to a variety of conditions by impugning immune function and increasing susceptibility to disease (Elliot, 2007).

Prevention and Management Options

Grass tetany is easily preventable. Analysis of forage should be performed prior to grazing dairy cattle if there is a history of grass tetany in the animals or on the pasture. If possible, fertilizers that are high in nitrogen and potassium should be avoided. When cattle consume forage high in nitrogen, a substantial amount of ammonia is produced in the rumen. If there is a large amount of ammonia present, dietary Mg may be converted to the unfavorable, insoluble hydroxide form. This lowers the availability of Mg in the blood and tissues (Allison, 2003).

Fertilizers that may be applied to raise Mg levels of the soil include dolomitic or high Mg limestone, which contains 12-13 % of actual Mg (Rayburn and Barringer, 1994). Dolomitic limestone is generally used when the soil pH is low. If the soil has a high pH, pastures can be dusted with a mixture of fertilizer containing magnesium oxide (MgO; Chambliss and Kunkle, 2003). Dusting the pasture with MgO is an effective method of increasing levels of Mg in the soil and subsequently, the animal; however, the solution is not very palatable. Filley (2005) suggests mixing MgO with dry molasses to make it more appealing to cattle.

Magnesium does not have to be added to the pasture, but can be supplemented directly into the diets of cattle, also in the form of MgO. Magnesium oxide is most effective when diluted (300 g/L of water), added to hay, and fed at a rate of 1 bale/10 cows (Harris and Hill, 1997). Magnesium oxide can also be mixed with salt and fed directly to cattle *ad libitum*. The salt increases the palatability of MgO as well as increases the sodium level in the blood. A

suggested mixture is 75 % salt to 25 % MgO (Allison, 2003). It has been shown that the balance of these two minerals may also help to increase the absorption of magnesium through the rumen (Berger, 2006). Magnesium can also be added to drinking water in the form of magnesium sulfate (Epsom salts) at a rate of 3.0 g/L. Magnesium sulfate is also not very palatable and water intake needs to be monitored to ensure that dehydration does not occur. Also, if too much magnesium sulfate is consumed, the animal may develop scours (Elliot, 2007).

New advances in plant development have led to the production of a variety of tall fescue grass that is high in Mg (HiMag). The plants are also free of endophytes which can decrease weight gain and cause reproductive problems in cattle. It was found that the HiMag variety contained 22 % more Mg than normal endophyte-free varieties of tall fescue (Au Triumph, Kentucky-31, Martin, and Mozark) as well as 18.5 % more Ca and 9 % more P. When calculating the risk of this forage causing grass tetany, the tetany ratio was 1.34 (>2.2 is considered a high risk level for developing grass tetany). The other varieties averaged 1.65, which was still below the threshold for causing grass tetany (Sleper et al., 2002).

Perhaps the easiest method of prevention is simply not grazing lactating or high risk cows on grass tetany "hazard" pastures and reserving the land for other livestock such as steers or dry cows. Instead, legume hay or high-legume pastures would provide a safer alternative for these animals. Not only is it safer for the cow, but because legumes are more digestible than grasses, it is likely that lactating cows will produce more milk (6-10 lb) when grazed on a legume stand. Another incentive is that when managed correctly, a legume pasture will produce just as much forage as a grass stand (Rayburn and Barringer, 2003).

Grass tetany is a serious, yet preventable disease caused by severely low levels of Mg in the blood. It can strike cattle at an alarmingly fast rate (acute form), which makes detection and treatment often difficult. Because of its rapid onset and its ability to cause death, it is best to try and prevent grass tetany, rather than treat it. Prevention involves raising levels of Mg in either the forage when cows are on pasture or feeding Mg supplements as part of a ration. With a good management program and regular forage testing when grazing lactating dairy cows, grass tetany and other diseases caused by mineral diseases can easily be prevented.

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