Understanding Grass Staggers (Hypomagnesaemia)

Introduction

Grass staggers occurs when the level of magnesium (Mg) in the cerebrospinal fluid (CSF) falls below a critical level. As the level of Mg in the blood declines prior to the Mg level in the CSF, measuring blood Mg level provides a guide about the Mg status of an animal. However, CSF Mg concentrations are maintained in relative constancy despite wide variations in plasma Mg concentrations.

Clinically the condition is characterised by hyper-excitability, muscular spasms (tetany) and convulsions. Hypomagnesaemia can be rapidly fatal. Outbreaks have been reported to occur where up to 20% - 30% of a cow herd can be found dead.

Aetiology

Magnesium has many physiological and biochemical functions, so it is essential for animal health and production. Magnesium serves as a co-factor for many enzymes and is required for the activity of some hormones.

Extracellular Mg is vital to normal nerve conduction, muscle function, and bone mineral formation. Magnesium deficiency potentiates an accumulation of acetylcholine at the motor neuron end-plates, causing neuromuscular excitability.

Magnesium Requirements

Maintenance of normal serum Mg is virtually wholly dependent on dietary magnesium absorption. There are no hormonal systems directly controlling plasma Mg concentrations. Magnesium homeostasis depends on a continual absorption of Mg from the rumen to provide the amounts lost in milk and endogenous secretions. When dietary intake exceeds daily requirement, Mg is excreted in the urine.

A lactating dairy cow requires 2g available Mg per day, plus 0.12g of Mg per litre of milk. This means a dairy cow producing 25L of milk per day requires 5g of available Mg daily.

Beef cattle have broadly similar requirements but generally produce less milk. A beef cow producing 10L milk per day requires 2.5g of available Mg per day.

Figure 1 (overleaf) describes magnesium flow in a cow.

Magnesium absorption occurs in the reticulorumen via both active and passive transport mechanisms. To be available for absorption, Mg must be in its soluble form in the rumen liquor. In general, ingested Mg is poorly available (average 17%). This means 20g Mg from pasture equates to 3.4g available Mg.

In addition, increased rumen pH, high dietary potassium (K), formation of insoluble Mg soaps in the rumen and rapid rumen transport rates all reduce Mg absorption from feed or oral supplements.

Predisposing Factors

Many factors can play a role in hypomagnesaemia.

Diet

1. **Low magnesium intake**
   - low Mg content in forage / feed (e.g rapidly growing pasture with low DM content)
   - reduced feed intake by the animal (e.g. inclement weather, yarding, transport)
2. **Rapid transit of feed through the rumen**
   - Lush pasture increases the rate of passage of ingesta through the rumen, meaning insufficient time is available for Mg solubilisation and absorption.
3. **Formation of insoluble complexes**
   - Mg can become bound in chelates or other insoluble complexes so the Mg cannot be extracted from food. This means Mg is unavailable for absorption, so passes through the rumen and is excreted in faeces.
4. **Interference by other minerals**
   - Potassium (K)
     High levels of dietary potassium (e.g. use of K fertiliser to increase spring pasture growth and yield) reduces absorption of Mg.
   - Sodium (Na)
     Low Na levels trigger aldosterone secretion. This hormone causes a decrease in Na in the saliva with a reciprocal increase in K. This increased K in saliva results in increased K in ruminal fluid. Consequently low Na has the same effect on Mg absorption as high dietary K.
   - Calcium (Ca)
     If the calcium concentration in blood decreases, the concentration of Mg in the CSF falls more rapidly when blood Mg decreases.
     Low Mg concentrations can inhibit the release of parathyroid hormone (an important hormone in calcium homeostasis). This can result in an impaired capacity to mobilise Ca stores and result in hypocalcaemia (milk fever).

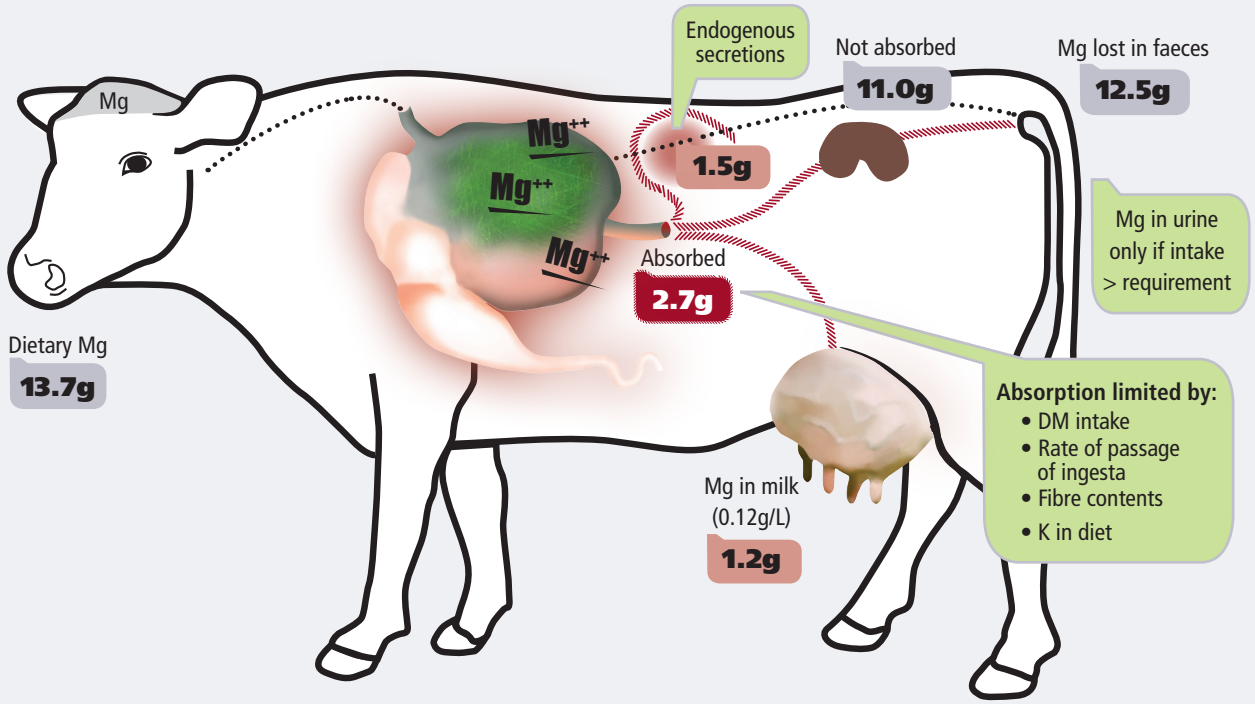

Fig 1. Magnesium flow and excretion in a 500kg lactating beef cow

Table 1. Forms of Magnesium supplementation

Mg salt (% Mg)	Recommended daily supplementation#	Amount of Mg ingested from daily supplementation	Mg availability	Daily Mg absorption*
Mg oxide (55%)	22 g drenched 44 g dusted	12 g	33%	4 g
Mg chloride (10%)	122 g	12 g	not published	4 g?
Mg sulphate (12%)	100 g	12 g	not published	4 g?
Mg alloy capsule (90%)	1 capsule for 9 – 12 weeks	2 g	100%	2 g

Jersey dairy cow, Dairy NZ recommendation 12 g Mg / day *assuming insignificant interference from other dietary factors

- Nitrogen
  High intraruminal ammonium ion concentrations reduce Mg absorption (additive and independent of the effect of K). This can be caused by ingestion of herbage with high nitrogen (N) and low soluble carbohydrate concentrations.

Cow Factors

1. Age

Most cases of hypomagnesaemia occur in cows > 4 years of age. It is rare for a first calving heifer to be affected, as heifer milk production (and therefore Mg demand) is lower than for a mature cow. Whilst there is considerable individual variation in a cow's ability to absorb Mg, in general as cows get older their magnesium absorption rates decrease.

2. Breed

Most susceptible				Least susceptible
Angus	Hereford	Jersey	Holstein	Brahman

'Least susceptible' cows have a higher ability to digest and absorb Mg.

3. Production

High levels of production mean that there is more demand for Mg. High producing cows are at a higher risk.

4. Body condition

Thin and over-fat cows are more at risk than cows in moderate body condition. Cows that lose body condition in early lactation are at risk as soft tissue has a much lower Mg content than grass. That is, a cow that maintains production partly by using body reserves is more likely to be in negative balance for Mg than one maintaining production just from eating pasture.

Management Factors

1. Fertiliser use

High levels of K and N fertiliser increase hypomagnesaemia risk as Mg absorption is reduced.

2. Reducing feed (therefore Mg) intake

Management factors such as yarding, moving, mustering, transport also reduce feed intake. This means Mg intake is reduced and can predispose "at risk" cattle to hypomagnesaemia. Weight loss in early lactation is also a risk factor.

Environmental Factors

Any additional stress on cows at the critical time around calving and lactation may predispose them to hypomagnesaemia. These stressors include wind, rain, exposure (lack of shelter); sudden change of feed and feed quality; sudden lowering of temperature. Mortality from hypomagnesaemia is frequently associated with inclement weather conditions.

Prevention

It is recommended that all cows are supplemented with additional magnesium, starting at least 2 – 3 weeks prior to calving.

Magnesium can be;

1. Top-dressed onto pasture
2. Added to silage and other feeds
3. Added to water troughs
4. Drenched to cows individually
5. Delivered into the rumen via a slow release intra-ruminal capsule

Refer to Table 1 for a summary of forms of Mg supplementation.

Summary

- Grass staggers occurs when dietary intakes of Mg are insufficient to meet metabolic needs
- It can be rapidly fatal and affect a significant proportion of cows on an individual property
- Hypomagnesaemia occurs when there is inadequate Mg intake; excess dietary K; lush pasture increasing the rate of passage of ingesta. Outbreaks are often preceded by inclement weather
- Prevention is critical and involves supplementing adult pregnant and lactating cows with additional Mg

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