Case Report Rapport de cas

Sand impactions in a Saskatchewan beef cow-calf herd

Nathan Erickson, Steven Hendrick

Abstract — Forty beef cows were reported to show signs of abdominal pain and discomfort over a period of 1 wk. Two of the affected animals died and on postmortem examination were found to be impacted with sand in their abomasum and small intestines. Sand-laden barley silage was found to be the cause of these impactions.

Résumé — Surcharge de sable chez un troupeau de bovins et de veaux de boucherie de la Saskatchewan. Des signes de douleurs et d'inconfort abdominaux ont été signalés chez quarante bovins de boucherie pendant une période de 1 semaine. Deux des animaux touchés sont morts et, à l'autopsie, il a été constaté qu'il y avait une surcharge de sable dans l'abomasum et l'intestin grêle. Il a été constaté que de l'ensilage d'orge chargé de sable était la cause de ces surcharges.

(Traduit par Isabelle Vallières)

Can Vet J 2011;52:74–76

In early December of 2007 a colic outbreak in a 500-head commercial beef herd located northwest of Saskatoon was investigated by the Western College of Veterinary Medicine (WCVM) disease investigation unit. The herd consisted of mature cows and bulls in 1 wintering area, and 2 groups of weaned calves in separate pens. The cows and bulls were fed a totally mixed ration including alfalfa-grass silage, chopped straw and hay, along with free-choice salt and well water. In late November the producer noticed that the herd was not consuming as much as expected and in response switched the silage from an older pile (2006) to a pile produced in the summer of 2007. Upon making this adjustment there was an increased intake; however, within 4–5 d the producer noticed behavioral changes in several of the mature animals. Approximately 10 mature cows separated themselves from the herd, kicked at their abdomen, and appeared reluctant to move. Over the next 6 d these signs waxed and waned involving approximately 10% of the mature cow/bull herd; none of the weaned calves were ever observed to have had these signs. Feed intake in the mature herd was reduced by approximately 30% at its worst. The producer sought advice from his veterinarian and a regional government livestock specialist, who later contacted the WCVM. In the initial communications with the producer it was identified that a large amount of the silage being fed was moldy; recommendations were made that the silage no longer be fed due to concerns about mycotoxins. An investigation into the cause of this outbreak was performed by the WCVM disease investigation unit and 2 private nutritional consultants.

Veterinary Agri-Health Services, Box 3684, Airdrie, Alberta T4B 2B8 (Erickson); Large Animal Clinical Sciences, Western College of Veterinary Medicine, University of Saskatchewan, 52 Campus Drive, Saskatoon, Saskatchewan S7N 5B4 (Hendrick).

Address all correspondence and reprint requests to Dr. Steven Hendrick; e-mail: steve.hendrick@usask.ca

Case description

The investigation began with a herd visit in early December 2007. On arrival the cows and bulls were finishing their feed and most of the cattle were eating in the rows of feed on the ground. The producer had separated 15 affected animals for close examination. In the remaining herd, 5 animals were observed with distinctly abnormal movements and behavior. These individuals were either lying down separate from the herd or standing on their own in a small group. They were reluctant to rise or move when we approached but did so slowly. One bull and 1 cow in particular appeared dull, hunched, and weak on the hind end. As these 2 walked their hind ends appeared to sway laterally and they occasionally scuffed their hooves. These signs were interpreted as general weakness as apposed to ataxia. When the animals rose from sternal recumbency they did so very slowly and stretched out their back ends for an extended period. The animals which the producer had separated from the herd acted in a similar manner. Of the group of 15 animals (14 cows and 1 bull) selected, 3 had diarrhea overnight, the first time this had been seen, and 1 had died overnight.

A postmortem examination was conducted on the mature cow (> 10-years-old) which had a history of colic. The most significant postmortem findings were in the alimentary tract. The abomasum was distended and filled with a large quantity of sand (estimated at 10 to 15 kg), and mixed with a small amount of feed material. A sand obstruction was also observed in the distal jejunum with the blockage extending approximately 10 cm. The serosa in the region of the obstructed intestine was moderately congested. Proximal to the blockage the intestines were severely dilated, had moderate serosal congestion, and were

Table 1. Summary of nutrient content from 2 alfalfa-grass silage samples collected from the top and middle of a silage pile

Nutrient	Top sample	Middle sample	Reference range[a]
Dry matter (%)	57.3	33.5	35–45
Crude protein (%)	5.5	12.7	15–20
Acid detergent fiber (%)	75.8	39.3	30–45
Total digestible nutrients (%)	17.7	56.7	50–60
Calcium (%)	0.59	1.58	1.3–1.4
Phosphorus (%)	0.08	0.14	0.30–0.36
Potassium (%)	0.75	1.87	1.5–3.0
Magnesium (%)	0.16	0.30	0.2–0.3
Sodium (%)	< 0.01	0.01	0.01–0.02
Sulfur (%)	0.061	0.176	0.1–0.35
Chloride (%)	0.38	0.38	0.5–1.75
Iron (ppm)	9247	399	200–400
Zinc (ppm)	30	26	27–33
Copper (ppm)	5	5	7–10

[a] Adapted from National Research Council, Nutrient requirements of beef cattle: 7th ed.

filled with red-brown fluid. There were no other significant abnormal findings. The severe abomasal and intestinal sand impaction was the most likely cause of death. Several tissue samples, including abomasum, intestine, kidney, liver, and heart, were taken for histopathology, but there were no significant findings (Prairie Diagnostic Services, Saskatoon, Saskatchewan). It should be noted that a 6-year-old bull was also found dead in mid-January 2008 with similar lesions to this cow. A probable cause of the sand impaction was found upon examination of the alfalfa-grass silage piles.

The alfalfa-grass silage produced in the summer of 2007 was stored in 2 piles (600 and 2200 tonnes) with no covering; as a result, the feed was largely spoiled on the sides and top. The spoiled region extended to a depth of approximately 50 cm, observed in the region that had been removed for feeding. The silage contained large amounts of granular material that was likely sand from the surrounding area. The fine sandy loam soil around the pile was disturbed indicating that sand was likely scraped into the pile while it was being packed in the summer. The sand was found extensively throughout the pile. Samples taken from the top and middle of the open face of the silage pile were sent for forage analysis using wet chemistry (ALS Laboratory Group, Saskatoon, Saskatchewan) and to be screened for 17 mycotoxins (Veterinary Diagnostic Laboratory, North Dakota State University, Fargo, North Dakota, USA). Both silage samples had no detectable levels of mycotoxins. A summary of the silage composition analyses is included in Table 1. The top silage sample was of poor quality with 5.5% crude protein (CP), 75.6% acid detergent fiber (ADF), and 17.7% total digestible nutrients (TDN), all measured on a dry matter basis. More interestingly, the top silage sample had ash and iron content of 14.5% and 9247 ppm, respectively; whereas, the middle silage sample was of average composition with 12.7% CP, 39.3% ADF, 56.7% TDN, 9.7% ash and 399 ppm iron. The ash content of alfalfa-grass silage is reported to range between 7.7% to 9% on a dry matter basis (1). The cows in this investigation were being fed from the top of the silage pile with high ash content (14.5%) and spoilage, while the asymptomatic calves were being fed from the middle of the pile. Using the silage analysis we were able to estimate the amount of sand being consumed daily by each cow. Assuming that a dry-pregnant 600-kg beef cow consumes 12 kg of dry matter per day and that 9% of the ash is from the silage and the remaining 5.9% is from the sand (sand is non-combustible and is therefore present in the ash portion) then each cow on average consumed 0.7 kg of sand per day.

Among the 14 animals removed for close examination, 11 had signs of colic and 3 did not. The mean temperature, mean age, and percentage pregnant were 39.2°C and 38.9°C, 5.8 y and 4.3 y, and 90% and 100% for those with coli and those without colic, respectively. Fecal and blood samples were collected from each of the 14 animals. Complete blood (cell) count and serum chemistry profile results showed very few significant abnormalities; a mild metabolic acidosis among 5 of the 14 animals was noted by a slightly increased anion gap. This metabolic acidosis may be attributable to the dietary cation anion difference (DCAD), which was calculated based on

$$(Na + K) - (Cl + S)$$

using data from silage analysis. A second possible explanation for the elevated anion gap is the high iron level in the silage.

Attempts were made to determine if sand was present in the fecal samples from the 14 animals. Fecal samples were mixed in water and allowed to settle such that the organic material would float and the inorganic material or sand would settle to the bottom; this is a method which is commonly used in horses. This test did not provide any result, due to digestive differences between horses and ruminants. Ruminants are able to digest fiber more completely and have feces which are less coarse and buoyant. It is also possible that the sand accumulated in the fore stomachs, rumen and intestines and was not being passed as has been seen in previous investigations of this type (2,3).

Discussion

The working hypothesis of this case was established after post-mortem examinations had been conducted on the 2 deceased animals and the silage was observed. The cause of death in both animals was determined to be sand impaction which was likely the result of consuming sand tainted silage. It is difficult, however, to determine conclusively that the cause of the outbreak of colic in the herd was due to the sand contaminated silage. Evidence of mild sand impaction in the remainder of the herd was difficult to assess because of lack of control animals with which to compare the results of the blood, fecal and physical examination. All calves remained asymptomatic despite being fed from the same silage pile. The main difference was that they were fed from the center of the silage pile as opposed to the spoiled and soiled top and sides. Furthermore, the owner of the herd was unwilling to have an exploratory laparotomy completed on the affected animals to confirm our diagnosis or to attempt removal of the sand.

Treatment was not attempted in the herd given the number of animals affected, extensive management utilized, and environmental conditions. In the only other reported case of sand impaction in a beef herd, tubs containing a mixture of mineral oil, molasses, epsom salts, and water were provided daily to the

animals (4). Unfortunately, the temperatures in west central Saskatchewan were too cold and such a mixture would have simply frozen. In retrospect, the more seriously affected cattle should have been treated individually with mineral oil per os.

The alfalfa-grass silage investigated differed from reference values for iron and ash content. The high level of iron was presumed by the referring nutritionist to be the result of soil contamination. Similarly, the ash level in the producer's silage was 5.9% to 7.2% higher than what would be expected in normal alfalfa-grass silage. Ash content represents the mineral component of a feed and is measured as the proportion of non-combustible dry matter (1). We may further classify ash as either endogenous or exogenous in origin. Some species of plants naturally contain relatively high levels of ash associated with the absorption, transpiration, and deposition of monosilicic acid in the leaves, stems, and hulls (5). Russian thistle (tumble weed, *Salsola kali*), Kochia (*Kochia scoparia*) and rice straw are reported to have endogenous ash contents of 12%, 13%, and 14%, respectively (5–7). The addition of sand to the silage in question contributes significantly to its ash content and is considered exogenous. Under normal harvesting conditions, we anticipate very little exogenous ash in forage samples. The presence of the sand impaction, the observation of colic and the significant amount of sand in the silage indicate that the silage is likely the source of the outbreak.

Very little information is available regarding similar cases. An outbreak of sand impaction of post-partum dairy cattle in Florida was diagnosed through surgical exploration and by observing differences in dietary cation-anion difference (DCAD) values (3). Unfortunately surgical exploration was not an option for this investigation; however, the DCAD was calculable through the results of the silage analysis. In the Florida case report, the DCAD level of the affected cattle was ≤ -110 mEq/kg, while the DCAD of the silage in the current investigation was calculated at -23 mEq/kg. In the previous study the DCAD calculation was of importance in establishing a reason for the pica which resulted in the sand impactions. It was hypothesized that the cattle were eating the sand in order to compensate for an imbalance of acid-base equilibrium or were displaying aberrant behavior. In the current case the soil was force fed in the ration and the DCAD indicates that there is an imbalance of ions in the silage and is a potential causative factor for the high anion gap. A second differential for the mild acidosis is the severe excess of iron in the silage. Elevated blood levels of iron reduce the serum bicarbonate ions while increasing other "unmeasured" anions, resulting in a high anion gap or metabolic acidosis (8).

Sand impaction in cattle is rare as it has only been reported once in a beef herd and once in a dairy herd (3,4). Overall, abomasal impactions occur infrequently in cattle. A retrospective study of 75 abomasal impactions in Saskatchewan revealed that 60% of obstructions were due to excess fiber in the diets, mainly the result of feeding straw in the winter with reduced water consumption (9). The remaining cases were due to traumatic reticuloperitonitis (20%) or other miscellaneous causes, including abomasal tears, ulcers and necrosis of the walls of the rumen, omasum or abomasum. A complicating risk factor in the herd investigation described in this report is that all 500 cows were watered from a single trough in a narrow alley way. This could have limited water access for these cows, further increasing their risk of abomasal impaction.

In another herd investigation there were 2 dry lot dairy cattle with evidence of a nonstrangulating intraluminal obstruction based on clinical examination and blood chemistry (2). The initial examination was followed by exploratory surgery in which the surgeons found gravel obstructions in the abomasum and duodenum. Abomasal obstructions are frequently related to the diet and are avoidable by feeding roughage with adequate digestibility and by ensuring that the roughage being fed is properly prepared without excess inorganic material.

Acknowledgments

The authors thank Drs. Vern Racz and David Whitehead for the nutritional information they provided. CVJ

References

1. National Research Council. Nutrient requirements of beef cattle. 7th revised ed. Washington, DC: Nat Acad Pr, 2000:54–74,133–148.
2. Cebra C, Cebra M, Garry F. Gravel obstruction in the abomasums or duodenum of two cows. J Am Vet Med Assoc 1996;209:1294–1296.
3. Melendez P, Krueger T, Benzaquen M, Risco C. An outbreak of sand impaction in postpartum dairy cows. Can Vet J 2007;48:1067–1070.
4. Hunter R. Sand impaction in a herd of beef cattle. J Am Vet Med Assoc 1975;166:1179.
5. Agbagla-Dohnani A, Noziere P, Gaillard-Martinie B, Puard M, Doreau M. Effect of silica content on rice straw ruminal degradation. J Agric Sci 2003;140:183–192.
6. Coxworth EM, Bell JM, Ashford R. Preliminary evaluation of Russian thistle, Kochia, and garden atriplex as potential high protein content seed crops for semiarid areas. Can J Plant Sci 1969;49:427–434.
7. Knipfel JE, Kernan JA, Coxworth EC, Cohen RD. The effect of stage of maturity on the nutritive value of Kochia. Can J Anim Sci 1989;69:1111–1114.
8. Constable P. Clinical assessment of acid-base status: Comparison of the Henderson-Hasselbalch and strong ion approaches. Vet Clin Pathol 2000;29:115–128.
9. Ashcroft RA. Abomasal impaction of cattle in Saskatchewan. Can Vet J 1983;24:375–380.