

## Left Displacement of the Abomasum in 4 Beef Calves

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**Background:** Little is known about the occurrence rate, underlying etiology or treatment of left displacement of the abomasum in beef calves.

**Objective:** Describe the clinical presentation, diagnosis and treatment of left displacement of the abomasum in 4 beef calves.

**Animals:** Four client-owned beef breed calves with left displaced abomasum (LDA).

**Methods:** Retrospective case series. Hospital medical records were reviewed to identify all beef breed cattle under the age of 6 months diagnosed with LDA.

**Results:** Four beef calves were treated for left displacement of the abomasum. All four had a history of decreased appetite and left-sided abdominal distention. Two had recently been treated for necrotic laryngitis and one was being treated for clostridial abomasitis. Ultrasonography confirmed the abomasum to be displaced between the rumen and the left body wall in all calves. The calves were initially treated by rolling to correct the abomasal displacement. The abomasum redisplaced in 3 of 4 calves within 1 hour to 6 days; 1 calf developed a mesenteric volvulus. A right paramedian abomasopexy was performed in all cases. Three of 4 calves grew well and remained in the herd 6–18 months later; 1 calf was euthanized because of complications associated with necrotic laryngitis.

**Conclusions and clinical importance:** Left displacement of the abomasum should be considered as a differential diagnosis for beef calves with abdominal distention. Concurrent necrotic laryngitis can increase the risk of abomasal displacement in beef calves. Treatment should include surgical correction as rolling is not curative and might be associated with mesenteric volvulus.

**Key words:** Bovine; Calf; Gastrointestinal; Left displaced abomasum.

Left displaced abomasum (LDA) is an uncommon condition in beef cattle compared with dairy cattle and is rarely described in sucking beef calves. Few investigations into the incidence and underlying etiology of LDA in calves have been reported.<sup>1</sup> It is difficult to gauge the frequency based on the literature, as there are very few documented cases of LDA in beef calves.<sup>2,3</sup> Except for a German report of LDA in five dual-purpose calves that presented within 1 year, most reports of LDA in calves describe individual incidences in dairy, dairy cross, or dual-purpose breeds.<sup>2–9</sup> One retrospective study of beef cattle describes 19 cases of abomasal displacement, but includes only a single case of LDA in a 13-month-old Brahman bull calf (the other 18 cases involve right displaced abomasum or abomasal volvulus).<sup>10</sup> There remains a paucity of information

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### Abbreviation:

LDA left displaced abomasum

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regarding the diagnosis and treatment of beef calves diagnosed with LDA. This report describes four cases of LDA in beef calves treated over a 29-month period of time.

### Materials and Methods

A retrospective review of medical records was conducted. Medical records from all calves under the age of 6 months that were treated between 2000 and March 2015 were reviewed and the age, breed and final diagnosis recorded.

### Results

Four beef breed calves between the ages of 2 weeks and 3 months were diagnosed and treated for LDA between November 2013 and March 2015.

#### Calf 1

A 2-month-old 68-kg (150-lb) mixed breed suckling beef bull calf was admitted for an approximately 1-month history of intermittent lethargy, inappetence, and failure to gain weight. Four weeks earlier, the calf had been diagnosed with necrotic laryngitis and treated with florfenicol<sup>a</sup> (20 mg/kg, SQ, q 4 days) and dexamethasone sodium phosphate<sup>b</sup> (1 mg/kg, IV, once).

On examination, the calf was lethargic, dehydrated (~8%) and had a body condition score of 4/9. The rectal temperature was 38.4°C (101.1°F), heart rate was 120 beats/min, respiratory rate was 60 breaths/min, and had bilateral abdominal distention, scant pasty feces, and decreased rumen motility. There was a high-pitched

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metallic “ping” and splash auscultated upon percussion and succussion of the left abdomen.

Blood gas and electrolyte analysis<sup>c</sup> revealed a hypochloremic, hypokalemic metabolic alkalosis. Ultrasound examination revealed mild, bilateral pleural surface irregularity and the abomasum was visualized dorsally between the rumen and left body wall. The calf was diagnosed with LDA and resolving pneumonia.

Conservative treatment by rolling was attempted to correct the LDA.<sup>11</sup> The calf was positioned in right lateral recumbency and rolled onto its back at which point the abdomen was agitated and percussion used to confirm that the abomasum had shifted toward the ventral midline. The calf was rocked back and forth for approximately 3 minutes to allow gas to percolate out of the abomasum. The calf was then rolled over into left lateral recumbency before being allowed to stand. Normal auscultation over the left abdomen as well as ultrasonographic visualization of the abomasum in the right paramedian position confirmed that the abomasum was no longer displaced to the left. Other treatments included 2 L of fresh rumen fluid from a donor cow, ceftiofur crystalline free acid<sup>d</sup> (6.6 mg/kg, SQ, once), and intravenous administration of 0.9% sodium chloride. The calf's physical condition markedly improved over the next 36 hours, but the abomasum redisplaced to the left twice. Each time it was corrected with rolling, but would redisplace within 18 hours.

On day 4 of hospitalization, a right paramedian abomasopexy was performed under general anesthesia. The calf recovered without complications and was discharged 2 days postoperatively. A recheck examination 2 weeks later revealed a bright calf with a shiny coat and normal abdominal contour. Ultrasound examination confirmed the correct anatomic position of the abomasum. The owner reported that the calf went on to gain weight and was sold at 6 months of age for competitive exhibition.

### Calf 2

A 2-week-old 30-kg (66-lb) mixed breed beef heifer was admitted for decreased appetite and signs of colic for which the owner had treated it with neomycin orally and milk replacer given via orogastric intubation. The calf was lethargic, dehydrated (~7%), and exhibited reflux of a pink foul-smelling fluid from the forestomachs when an orogastric tube was passed. Gram stain of the ruminal fluid showed numerous large gram-positive rods, and was tentatively diagnosed with clostridial abomasitis. Initial treatment included intravenous administration of 2.5% dextrose in a balanced electrolyte solution, ceftiofur hydrochloride<sup>e</sup> (2.2 mg/kg, SQ, q24h), pantoprazole<sup>f</sup> (1 mg/kg, IV, q24h), and three doses of *C. perfringens* type C, & D antitoxin<sup>g</sup> (10 mL, SQ, q24h).

On day 4 of treatment, the calf developed left-sided abdominal distention and a ping and splash were detected upon percussion and succussion of the abdomen. Ultrasound examination confirmed the suspicion of a LDA. A venous blood gas and electrolyte analysis<sup>c</sup>

revealed hypochloremia, hypokalemia, and elevated TCO<sub>2</sub>.

The LDA was treated by rolling the calf as previously described for calf 1. Rolling appeared to successfully replace the abomasum to its normal location, but within 30 minutes of rolling, the calf became acutely painful and began kicking at its abdomen. Ultrasonographic evaluation later in the day revealed numerous dilated small intestinal segments and copious free abdominal fluid. A right paramedian exploratory celiotomy under local anesthetic block revealed dark red loops of small and large intestine resulting from a volvulus at the root of the mesentery. The volvulus was corrected and a right paramedian abomasopexy performed. The calf recovered from surgery uneventfully and was discharged 3 days postoperatively. The owner reported that the heifer was healthy and growing as expected 18 months later.

### Calf 3

A 3-month-old 181-kg (398-lb) Beefmaster bull calf was admitted for bloat of 3 days duration. The calf was being fed grass hay and creep feed in addition to nursing the dam, but its appetite decreased since the onset of signs. The calf had been treated with poloxalene, mineral oil, probiotics, and unspecified antibiotics without improvement.

On admission, the calf was lethargic and dehydrated (~8%) and had a normal rectal temperature 39.2°C (102.5°F), heart rate of 76 breaths/min, and respiratory rate 32 beats/min. Left-sided abdominal distention with a ping and splash was heard upon abdominal percussion and succussion. Venous blood gas and electrolyte analysis<sup>c</sup> revealed hypochloremia, hypokalemia, and metabolic alkalosis. Ultrasound examination of the abdomen confirmed the diagnosis of LDA.

The LDA was treated by rolling as previously described for calf 1. After this treatment, the abomasum returned to its normal anatomic location based on ultrasound examination and the absence of a left-sided ping. The calf was given oral electrolyte solution and rumen fluid transfaunate via orogastric tube. The abomasum did not redisplace during the subsequent 5 days of hospitalization. The calf was discharged with instructions to slowly reintroduce the creep feed and to monitor for recurrence of left-sided abdominal distention.

Six days after discharge (12 days after rolling) the calf was readmitted because of recurrence of left-sided abdominal distention. The calf had a rectal temperature of 38.8°C (101.8°F) and respiratory rate 30 breaths/min, but was tachycardic (112 beats/min) and dehydrated (~8%). A ping and splash were detected upon succussion and percussion of the left paralumbar fossa. The calf was diagnosed with an LDA. Rolling was again attempted as treatment, but the abomasum redisplaced within a few minutes. Feed was withheld overnight and preoperative ceftiofur crystalline free acid<sup>h</sup> (6.6 mg/kg SQ, once) and flunixin meglumine<sup>i</sup> (1.1 mg/kg, IV, q12h) were administered. A right paramedian abomasopexy was performed the next day under sedation and

local anesthetic block. The calf recovered from surgery uneventfully and was discharged 7 days postoperatively. Six months later, the owner reported that the calf was growing well and had experienced no complications.

### *Calf 4*

A 4-week-old 50-kg (110-lb) Aberdeen Angus bull calf was admitted for intermittent bloat of approximately 10 days duration. The calf had been previously diagnosed with necrotic laryngitis and treated with an emergency tracheostomy and laryngostomy as a result of scarring of the arytenoids.

The calf was febrile 40.4°C (104.7°F), tachycardic (120 beats/min), and dyspneic with increased inspiratory stridor (60 breaths/min). The laryngostomy site was almost completely occluded with granulation tissue. The calf had left-sided abdominal distention and a left-sided ping and splash were ausculted on percussion and succussion. Venous blood gas and electrolyte analysis<sup>c</sup> revealed hypochloremia and elevated TCO<sub>2</sub>. Ultrasound examination of the abdomen confirmed a diagnosis of a LDA.

The calf was rolled as previously described and correct anatomic location of the abomasum confirmed via ultrasonography. Two days later, the abomasum redisplayed to the left and the calf was rolled again. After the rolling procedure the abomasum remained persistently displaced slightly toward the left as seen on ultrasound examination, but no ping or splash developed. The calf was treated with tulathromycin<sup>l</sup> (2.5 mg/kg, SQ, once) and meloxicam<sup>k</sup> (0.5 mg/kg, PO, q48h) and taken to surgery 4 days later for simultaneous permanent tracheostomy and a right paramedian abomasopexy. The calf recovered from surgery well, but later developed aspiration pneumonia with pulmonary abscessation and was euthanized 1 week after surgery. Necropsy examination revealed no gross abnormalities associated with the abomasum.

### **Discussion**

The 4 cases described in this report illuminate several features worthy of consideration regarding the occurrence, etiology, diagnosis, and treatment of LDA in beef calves. Although generally considered rare, the incidence of LDA in beef calves remains unknown. Interestingly, to the authors' knowledge, necrotic laryngitis has not previously been described as a concurrent illness in calves diagnosed with LDA. Ultrasound imaging of the abomasum offers a convenient, non-invasive tool to help diagnose and treat beef calves with LDA. This report highlights the importance of surgical treatment as conservative treatment with rolling was not successful long-term and was associated with mesenteric volvulus in one calf.

All 4 calves presented between November 2013 and March 2015. A search of the veterinary teaching hospital medical records identified 146 sick or injured beef calves under the age of 6 months that were treated during this time period. Thirty-eight of these calves were

diagnosed with a primary gastrointestinal disease, including the 4 calves with LDA. It is our impression that this represents an overestimation of the prevalence of LDA within the beef calf population (4/146, 2.7%) and within the population of calves with gastrointestinal disease (4/38, 10.5%). One explanation is that complicated GI cases that do not respond to initial treatment are more likely to be referred, and could be a source of bias within our population. However, only calf 3 was a referral. The recent increase in beef calves diagnosed with LDA can be attributed to heightened awareness of the disorder, or reflect the increased willingness of owners to pursue treatment of sick calves because of their presently high economic value. Additional investigation is needed to determine the prevalence of LDA in beef calves and whether beef calves, like adult beef cattle, have a lower risk of developing LDA compared with dairy calves.<sup>12</sup>

The etiology of LDA in calves is poorly understood. It is generally agreed that abnormal gas accumulation in the abomasum is a prerequisite for displacement. The source of the gas is debated, but it is thought to result from either impaired gas transport caused by reduced abomasal motility, or increased gas production in the rumen or abomasum.<sup>1,9</sup> It is possible that coexisting necrotic laryngitis and abomasitis predisposed 3 of the calves reported here to development of LDA by allowing for gas accumulation within the abomasum. It is also conceivable that bottle feeding contributed to development of LDA in these three calves. The bottle-fed calves received large infrequent meals that could have disrupted normal abomasal motility and the act of bottle feeding could have contributed to aerophagia and subsequent LDA. Breed has been associated with an increased risk of abomasal displacement with Hereford having a higher risk of LDA and Brahman-influence cattle having a higher risk of right abomasal displacement and abomasal volvulus.<sup>10,12</sup> Calf 2 was a mixed breed calf with Brahman and Hereford influence and calf 3 had strong Brahman influence, which suggests breed may have predisposed these calves to developing LDA. Cases of LDA in adult cattle tend to cluster in early spring.<sup>12</sup> In contrast, the calves reported here presented in October, November, January, and April suggesting that the seasonal factors predisposing adult cattle to developing LDA might not apply to beef calves.

Concurrent disease is common in adult cattle and calves with LDA.<sup>7,12</sup> Thirty-six of 47 dairy heifer calves that developed LDA also had a concurrent illness, most commonly bronchopneumonia.<sup>7</sup> Calves 1 and 4 likely had concomitant laryngeal dysfunction secondary to necrotic laryngitis. Necrotic laryngitis has not been previously reported as a concurrent illness in calves with LDA, but may enhance susceptibility via both suspected etiologies. Laryngeal necrosis and inflammation could lead to increased gas accumulation by compressing the esophagus and hindering eructation or impairing vagal nervous regulation of the abomasum. Moreover, deformation of the arytenoid cartilages could cause some degree of aerophagia, especially in nursing calves,

further increasing abomasal gas accumulation. Calf 2 was diagnosed with clostridial abomasitis before developing an LDA. The inflammation resulting from abomasitis with suspected abomasal ulceration likely decreased the calf's abomasal motility and may have predisposed it to abomasal displacement. This calf may also have had abomasal ulceration as a result of the clostridial infection. In reports of calves with concurrent abomasal ulceration and LDA, it is not known whether the abomasal ulceration leads to atony with subsequent displacement or if the displacement contributes to ulcer formation.<sup>1,9</sup>

Diagnosing LDA in at-risk beef calves can be challenging, as the clinical signs may be subtle. The calves reported here showed bulging of the left abdomen just caudal to the last rib. This clinical sign appears to be common to dairy and beef calves and when present, should alert the clinician to the possibility of LDA.<sup>1,2,7</sup> However, this bulging can be difficult to appreciate, and can be masked by abdominal distention related to another cause. The left-sided ping sound commonly used to help diagnose LDA in adult cattle can be subtle in beef calves, especially after attempted correction by rolling. In addition, finding a left-sided ping and splash in a calf is not pathognomonic for LDA. Other differentials for a left-sided ping and splash in a calf include abomasitis, rumen ping, and peritonitis.

In the cases reported here, abdominal ultrasonography was a simple, non-invasive means of confirming a clinical suspicion of LDA and monitoring abomasal position after rolling. The normal ultrasonographic appearance of the abomasum in calves has been described.<sup>13</sup> Imaging the abomasum dorsally between the rumen and left body wall in conjunction with medial displacement of the rumen has been reported as ultrasonographic evidence of LDA in adult cattle.<sup>14</sup> Similar ultrasonographic abnormalities were readily identifiable in the calves reported here and accurately identified LDA in all four cases. In light of its utility in diagnosing LDA in beef calves, ultrasonography may obviate the need for an exploratory surgery in cases with subtle clinical signs.

In the calves described here, blood gas and electrolyte analysis supported a clinical suspicion of LDA. The hypochloremic and hypokalemic metabolic alkalosis found in 3 of the calves is consistent with the most common metabolic changes in adult cattle diagnosed with LDA.<sup>15</sup> In all cases, the clinicopathologic abnormalities normalized after surgical treatment. Metabolic abnormalities reported in calves with LDA are inconsistent with decreased blood pH, and serum chloride and calcium concentrations reported in dairy calves with LDA.<sup>7</sup> It is possible that this inconsistency reflects an etiologic difference in beef versus dairy calves. Based on the cases reported here, identifying hypochloremia, hypokalemia, and metabolic alkalosis can lend support for the diagnosis of LDA in beef calves with subtle clinical signs.

Conservative treatment with rolling and diet modification was not successful as a cure in the 4 calves reported here. In each case, the abomasum redisplaced within

hours to days, eventually necessitating surgical treatment. In contrast, Dirksen reported that treatment with rolling and massage cured 19 of 21 calves in which it was attempted.<sup>1</sup> The difference in success rates may be because of monitoring the anatomical position of the abomasum as well as duration of the follow-up period. For example, it was thought that calf 3 was cured by conservative management until it was brought back 6 days later with a recurrence of the LDA. Rolling without concurrent correction of the underlying impetus for the abomasal displacement could allow for recurrence of the condition. Adult dairy cattle with LDA that are treated with rolling often redisplace within 1 month to 1 lactation period.<sup>11,16</sup> In the cases reported here, scaring of the arytenoid cartilages or vagal nerve damage in calves 1 and 4, and ongoing abomasitis in calf 2, could have contributed to recurrence of the LDA after rolling. In all 4 calves, the displaced abomasum was easily repositioned during surgery. Abdominal exploration revealed no anatomic abnormalities or adhesions that could explain the failure of rolling to affect a cure.

Although rolling a calf is considered conservative treatment for an LDA, it is not without risk. Dirksen recommends conservative treatment with rolling no more than 3 times and advocates taking calves with LDA to surgery early in the disease process.<sup>1</sup> Mesenteric volvulus as a result of rolling as treatment for an LDA has been previously described in a 5-year-old Red Holstein-Friesian cow.<sup>17</sup> In that case, the cow was restless and painful after the rolling procedure and died 3 hours later. Mesenteric volvulus was also reported within 24 hours of roll-and-toggle abomasopexy in 1/31 and 1/37 cows in separate reports.<sup>18,19</sup> Similarly, calf 2 developed a mesenteric volvulus after the rolling procedure that required surgical intervention. Therefore, calves should be monitored closely for signs of abdominal discomfort in the hours after rolling as the process can induce a fatal ischemia of the intestines and cecum as a result of mesenteric volvulus.

Multiple surgical techniques have been described for managing LDA in calves including left paralumbar fossa abomasopexy, right paralumbar omentopexy, right paracostal abomasopexy, and right paramedian abomasopexy.<sup>20,21</sup> Calves are likely to lie down during surgery, so a recumbent technique was chosen. In addition, the omentum is thinner and more fragile in calves; therefore, an abomasopexy was performed because it offered the advantage of direct adherence of the abomasum to the body wall. Positioning the calves in dorsal recumbency for a paramedian approach was chosen over the lateral approach of the paracostal incision as a result of enhanced restraint of the former technique albeit at some additional stress on the cardiopulmonary system. The lateral paracostal technique might be better suited for more severely debilitated patients or those with significant pulmonary disease. The right paramedian abomasopexy surgical technique used in the described cases should be considered when correcting LDA in beef calves, as it was technically practicable, facilitated good restraint with modest sedation, and delivered successful results.

In summary, LDA is likely more common in beef calves than many veterinarians recognize and should be considered as a differential for calves that present with abdominal distention. Concurrent laryngeal dysfunction has not been previously described in beef calves with LDA and may be a contributing factor in the pathogenesis of this disorder. Ultrasonography is a widely available chute-side diagnostic technique that can rapidly confirm the diagnosis in calves. Rolling is a useful adjunctive measure for allowing improvement in cases with severe metabolic alterations, but is often temporary. In addition, rolling can be associated with catastrophic intestinal complications in calves as has been reported in adult cows. Surgical correction is recommended, and right paramedian abomasopexy under sedation and local block is a feasible method of correction of LDA for the practitioner.

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### Footnotes

- <sup>a</sup> Nufloor, Merck Animal Health, Madison, NJ  
<sup>b</sup> Dexamethasone-SP, VETone, Boise, ID  
<sup>c</sup> VetScan iSTAT 1 Analyzer, Abaxis; Princeton, NJ  
<sup>d</sup> Excede, Zoetis, Florham Park, NJ  
<sup>e</sup> Excenel, Zoetis  
<sup>f</sup> Protonix, Pfizer, New York, NY  
<sup>g</sup> Clostridium Perfringens C & D Antitoxin; Colorado Serum Company, Denver, CO  
<sup>h</sup> Excede, Zoetis  
<sup>i</sup> Banamine, Merck Animal Health, Madison, NJ  
<sup>j</sup> Draxxin, Zoetis  
<sup>k</sup> Meloxicam, Unichem, Rochelle Park, NJ

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*Off-label Antimicrobial Declaration:* Authors declare no off-label use of antimicrobials.

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