



## Abomasal disorders in cattle: Insights into prevalence, clinico-pathology and ultrasonographic examination

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### ABSTRACT

This study was carried out to study the prevalence and comprehensive approaches in the diagnosis of abomasal disorders in cattle. The prevalence of abomasal disorders was 41.7% of abomasal ulcer, 33.3% of right displacement of abomasum, 16.7% of left displacement of abomasum, 5.6% of abomasal bloat and 2.8% of abomasal impaction. Crossbreed Jersey cow and recently calved animals were predominantly affected. Absence of feed intake, decreased milk yield, absence of rumination, bruxism and fed with rice were recorded as common history of abomasal disorders. Predominant clinical findings of animals affected with abomasal disorders were depressed demeanour, bruxism, pale conjunctiva, reduced rumen protozoa, melena and tachycardia. Nine cases were positive for fecal occult blood test and 10 cases of melena were noticed. Reduction in Hb, PCV, RBC, MCHC, TP and globulin were observed in the abomasal disorder cases. Increased BUN and bicarbonate level were noticed. Reduction in serum calcium, phosphorous and potassium were noticed. Rumen chloride was increased in all the abomasal disorder cases. Highly significant increases in the serum pepsinogen and NEFA were noticed in all the abomasal disorders. The ultrasonographic changes were assessed in all abomasal disorders based on location, echogenicity of abomasal contents and motility. *Staphylococcus thermophiles*, *Bacillus thermophiles*, *Candida* spp., *Pseudomonas* spp. and *Fusobacterium* spp. were isolated from abomasal fluid. Comprehensive approach enables early detection and timely implementation of treatment and management protocols for abomasal disorders in cattle.

**Keywords:** Abomasal displacement, Abomasal ulcer, Cattle, Serum pepsinogen, Ultrasound

Abomasal disorders cause significant gastrointestinal issues in cattle, mostly observed in high-yielding dairy cows. Bovine abomasal disorders are mainly predisposed by metabolic disturbances, lactation stress and nutritional deficiencies (Zaghloul *et al.* 2009). The commonly reported abomasal disorders are left abomasal displacement (LDA) and right abomasal displacement (RDA), abomasal volvulus (AV), abomasal impaction, abomasal ulcer and abomasitis (Radostits *et al.* 2007). The etiology of abomasal displacement can be multifactorial. Feeding high carbohydrates with inadequate roughage and crude fiber (below 17%) during the last week of pregnancy was the most important risk factor for abomasal displacement (Constable *et al.* 2017). Similarly, poor management practices and energy imbalance were the major risk factors for abomasal displacement in high-producing dairy animals (Coskun *et al.* 2022). Diagnosis of abomasal lesions in cattle is challenging because the clinical signs are subtle and non-specific, especially with non-perforating abomasal ulcer. Ultrasonographic examination of abomasum helps to access its position, size, contents and other inflammatory

lesions that surround the abomasum. There are limited studies on the prevalence and comprehensive approaches of abomasal disorders in cattle in India. Considering these limitations, the study aimed to study the prevalence and comprehensive approaches in diagnosing abomasal disorders in cattle.

### MATERIALS AND METHODS

In the present study, 442 cattle with various gastrointestinal disorders were presented to Large Animal Medicine Unit, Veterinary Clinical Complex (VCC), Veterinary College and Research Institute, Orathanadu, Thanjavur, for a period of one year during the year 2022-2023. Six apparently healthy cattle were randomly selected to obtain normal data for the parameters under study. The recorded abomasal disorders were grouped as left displacement of abomasum, right displacement of abomasum, abomasal ulcer, abomasal bloat and abomasal impaction.

**Clinical assessment:** A thorough clinical anamnesis and signs recorded were duration of illness, feed intake, rumination, feeding habits, melena, colic, bruxism, any recent transport, previous treatment, nature of dung voiding and milk yield in all the disorder cases.

**Laboratory analysis:** Parameters studied were Hb, PCV,

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RBC, WBC, DLC, Erythrocytic indices, BUN, creatinine, total protein, albumin, globulin, AST, calcium, magnesium, phosphorous, sodium, potassium, chloride and rumen chloride.

**Blood gas analysis:** It was done using a CG4 cartridge in a handheld blood analyzer (i-STAT 1®).

**Serum pepsinogen and NEFA** was estimated by ELISA method as per the manufacture's instruction.

**Ultrasonographic examination:** Transabdominal ultrasound evaluation of abomasum was performed in standing animals without any sedation. This study used a colour Doppler ultrasound (My Lab one Vet®) with a 2.5 to 5 MHz convex probe. The abomasocentesis was performed on standing position with ultrasound guidance as per the standard operating procedure (Braun 2003). The collected abomasal fluid was subjected to pH, microscopic and culture examination was done to identify the pathogens (Braun 2009).

**Statistical analysis:** One-way analysis of variance (ANOVA) and post hoc tukeys test was used for multiple comparisons between control and abomasal disorder groups of cattle. A value of  $p < 0.05$  was considered as significant in all statistical analyses.

## RESULTS AND DISCUSSION

In the present study, 442 cattle were showed signs of gastro intestinal disorders, among those 36 cattle (12.2%) had various abomasal disorders. Among these cases, 41.7% were diagnosed with abomasal ulcer, 33.3% with RDA, 16.7% with LDA, 5.6% with abomasal bloat and 2.8% with abomasal impaction. The occurrence of abomasal disorders were depends on the environment of animal which rearing, feeding pattern, stress factors and pregnancy (Dezfouli *et al.* 2013). In most of the previous studies on abomasal displacement, the higher incidence was recorded in left side, but contrast in our study, the occurrence of RDA was higher than that of LDA. In this study, it could be attributed to the feeding practices of cattle owners, 44.4% of the cattle were fed with rice. This resulted in an increased production of gas within the abomasum, specifically carbon dioxide, methane and nitrogen. The elevated gas production in the abomasum led to distention, reduced motility and subsequent outflow disorders, which causing the abomasum to become displaced on either side

of the abdomen. As reported by Doll *et al.* (2009) further support these findings, reduction in rumen protozoa, a lower limit of rumen pH and increases in rumen chloride, along with hypocalcaemia were noticed. Also, there was no proper consensus among the researchers that abomasal displacements were higher on the left than on the right side.

The highest incidence of left displacement of abomasum (13.9%) and abomasal ulcer (25%) were noticed mostly in more than 4 years of aged cow. Older cows were mostly affected by LDA compared to younger animals, especially between 4-7 years of age. Parturition could predispose to LDA, so the probability of abomasal displacement increased with the number of pregnancies (Radostits *et al.* 2007). In our study, 13.9% of calves had abomasal ulcers. Young rapidly growing calves were frequently affected and authors suggested that it could be due to feeding of large amount of milk that leads to altered pH which causes abomasitis followed by ulceration (Fubini and Divers 2008). In this study, 91.7% of female animals were found to have higher prevalence of abomasal disorders compared to males (8.3%). Stress conditions like pregnancy and parturition were predisposed to the occurrence of abomasal disorders more in female (Tajik *et al.* 2012). Higher incidence of all the abomasal disorders were observed in CBJ (66.7%) followed by HF cross (19.4%), Tharparkar (5.6%), Kangeyam (2.8%) and Umblachery (5.6%). There were higher incidences of abomasal disorders in CBJ, which could be attributed to the predominant population of this dairy breed in the study area. The highest percentage was recorded in recently calved (46.4%) cattle. Higher prevalence was mostly noticed in the first 6 weeks of lactation and the changes in feeding behaviour was considered a major risk factor for abomasal displacement (Fubini and Divers 2008).

Predominant clinical history of the abomasal disorders includes lack of appetite (66.7%), reduced milk production (66.7%), absence of rumination (58.5%), bruxism (47.2%) and rice feeding practice (44.4%) (Supplementary Table 1). Similar findings like reduced feed intake, decreased milk production, distended abdomen on left side, with scanty feces were noticed by Aly *et al.* (2016). Reduced milk production could be due to decreased production of volatile fatty acid and pale mucous membrane due to severe blood loss (Yasaswini *et al.* 2021). Abdominal pain due to over

Table 1. Serum electrolyte, pepsinogen, NEFA and rumen chloride abomasal ulcer and displacements (RDA and LDA) of cattle

Parameter	Unit	Control (n=6)	Abomasal ulcer (n=15)	RDA (n=12)	LDA (n=6)	p value
Ca <sup>+</sup>	mg/dl	11.40±0.36 <sup>b</sup>	7.91±0.3 <sup>a</sup>	8.25±0.72 <sup>a</sup>	7.62±0.71 <sup>a</sup>	0.001**
P <sup>+</sup>	mg/dl	4.78±0.18 <sup>b</sup>	4.33±0.37 <sup>ab</sup>	3.25±0.33 <sup>a</sup>	3.39±0.3 <sup>ab</sup>	0.025*
Mg <sup>+</sup>	mg/dl	2.89±0.13	2.92±0.12	2.97±0.19	2.77±0.24	0.887 <sup>ns</sup>
K <sup>+</sup>	mmol/L	4.69±0.14 <sup>a</sup>	3.47±0.06 <sup>b</sup>	3.53±0.24 <sup>b</sup>	3.46±0.29 <sup>b</sup>	0.001**
Sodium	mmol/L	135.68±1.21	134.05±1.74	133.18±2.21	141.10±5.27	0.230 <sup>ns</sup>
Chloride	mmol/L	101.22±2.6	93.48±1.53	90.98±1.82	93.00±5.32	0.072 <sup>ns</sup>
Rumen chloride	mmol/L	24.48±1.28 <sup>a</sup>	56.21±3.46 <sup>b</sup>	65.18±2.96 <sup>b</sup>	63.50±4.21 <sup>b</sup>	0.000**
Pepsinogen	U/L	2.08±0.44 <sup>a</sup>	8.73±0.85 <sup>b</sup>	6.30±0.53 <sup>b</sup>	7.04±0.82 <sup>b</sup>	0.000**
NEFA	mmol/L	0.35±0.04 <sup>a</sup>	0.66±0.02 <sup>b</sup>	0.74±0.02 <sup>b</sup>	0.75±0.02 <sup>b</sup>	0.000**

RDA: Right displacement of abomasum; LDA-Left displacement of abomasum; Ca<sup>+</sup> : Calcium, P<sup>+</sup> : Phosphorous, K<sup>+</sup> : Potassium and Mg<sup>+</sup> : Magnesium, NEFA: Non esterified fatty acids.

stretching of abomasal wall leads to visceral pain. Further, depressed demeanor (77.8%), bruxism (55.6%), pale conjunctival mucous membrane (47.2%), reduced rumen protozoa (44.4%), melena (38.9%) (Supplementary Fig. 1) and tachycardia (38.9%) were the predominant clinical signs recorded in our study (Supplementary Table 2). Heart rate and respiratory rate were increased in all disorders. Similar findings observed by Dezfouli *et al.* (2013) and El-Attar *et al.* (2007) and it might be due to hypovolaemia and toxemia. Abomasal bloat has considered to be a life-threatening condition of young calves, mainly by feeding excessive milk at irregular intervals. That causes sudden filling of abomasum which decreases abomasal emptying rate. In our study, abomasal bloat (n=2) was reported in calves less than 3 month of age with the history and clinical signs of reduced feed intake, melena, bruxism, colic pain, tachycardia, tachypnea and absence of dung for the period of 3 days. These findings concurred with Constable *et al.* (2017). Abomasal impaction was a rarely reported condition in cattle when the abomasal contents become dry and harder than normal abomasal contents and the size would be larger. In our study, the clinical signs of depressed demeanor, tachycardia, colic, anorexia and bruxism were noticed in one case. Similarly, El-Ashker *et al.* (2018) reported abomasal impaction with clinical signs of inappetance, tympany, chronic weight loss and decreased fecal output. In the present study, only 9 animals (40.9%) were positive for fecal occult blood test (FOBT). Hussain *et al.* (2016) reported in his study only 11 cases were positive (supplementary Fig. 2) out of 1,332 animals by HEMOSPOT kit. Decrease in ruminal contractions and protozoa were noticed in all the abomasal disorder cases. Reduced rumen motility in both LDA and RDA might be because of distended abomasum, it causes decreases motility through vagus nerve and hypocalcemia (El-Attar *et al.* 2007). Increased rumen chloride was noticed (56-63 mmol/l) in all the abomasal disorders cases. Pyloric stenosis leads to the backflow of hydrochloric acid from the abomasum into the rumen instead of duodenum, thus elevating the rumen chloride levels (Yasaswini *et al.* 2023).

Previous workers were reported increased hemoglobin and packed cell volume were observed in abomasal displacements, but contrast findings were recorded in the present study, low Hb and PCV (Supplementary Table 3) could be due to poor nutrition and preexisting anemia of the affected cases (Dezfouli *et al.* 2013). Brockus (2011) reported macrocytic normochromic anemia in bleeding abomasal ulcer. Similarly, in the present study also, cattle had macrocytic normochromic anemia. The elevated BUN in affected animals might be due to pre-renal azotemia as a result of hypovolemia that reduces the renal blood flow (Braun *et al.* 2019). Reduction in total protein, hypoalbuminemia in both abomasal ulcer and right abomasal displacement were noticed. These findings were accorded with Tharwat and Ahmed (2012) who reported that it might be due to reduced feed intake, poor absorption and decreased synthesis from the liver (Dezfouli *et al.* 2013).

Hypokalemia and hypocalcemia reported in all cases (Table 1). Yasaswini *et al.* (2021) reported hypokalemia due to shift of potassium from extracellular space to intracellular space as result of metabolic alkalosis results continuous HCl and potassium secretion into the abomasum. Hypocalcemia might be due to inappetance and reduced gut absorption as a result of abomasal atony (Yasaswini *et al.* 2021). Subclinical puerperal hypocalcemia plays an important role in abomasal displacement as it affects the tone of abomasal wall and leads atony of the abomasum. Increased serum pepsinogen levels were observed in abomasal ulcers and displacement (Table 1). Hajimohammadi *et al.* (2017) recorded increased serum pepsinogen (>5U/L) in LDA and RDA animals. Abomasal distension leads increased abomasal pressure which predisposing the gastric mucosal damage by back diffusion of hydrogen ions (Mamak *et al.* 2022). NEFA also increased in all the abomasal disorders (Table 1). Similar findings were reported by Zadnik (2003) with left displacement of abomasum (>0.35 mmol/l). Increased NEFA was mostly observed during first month after calving and primarily due to negative energy balance. Increased bicarbonate levels were observed in all types of disorders, with the highest level was observed in left displacement of abomasum cases. Aly *et al.* (2016) noted an increase in bicarbonate levels in abomasal displacement. Further authors stated that this could be due to a reduced secretion of bicarbonate from the pancreas and decreased ingesta passage from the abomasum to the duodenum, leading to an increase in HCO<sub>3</sub> level in the extracellular space. There was no significant difference was noticed in parameters like pH, lactate, PaO<sub>2</sub>, PaCO<sub>2</sub>, SO<sub>2</sub> and TCO<sub>2</sub> between control and abomasal disorders group (Supplementary Table 4).

All the abomasal disorders underwent for thoracic radiography and none of the cases were recorded with foreign body or pericardial effusion. Braun *et al.* (2020) reported that thoracic radiographic aids to differentiate TRP and abomasal ulcer in cattle. Ultrasonographic changes of abomasum were evaluated based on its location, echogenicity (homogenous/ heterogenous and presence of gas), appearance of abomasal fold and presence of motility/ contraction of abomasal contents. In the present study, ultrasound was very useful to identify the abomasal disorders. The ultrasound findings (Supplementary Table 5, Fig. 1-4). The recorded ultrasound findings were accorded with Braun (2009), Saravanan *et al.* (2019), Braun *et al.* (2022). The pH of abomasal fluid was 1-3 in range and the colour of the abomasal fluid varied from dark green, straw green, milky, muddy and slight yellowish. Consistency was watery to mild viscous (Supplementary Table 6). Occult blood test of abomasal fluid revealed 9 positives out of 36 cases. These findings were accorded with Braun *et al.* (1997 and 1997a) who also studied occult blood test in abomasal fluid. Normally the abomasal fluid should not contain blood, presence of blood indicates abomasal hemorrhage or chronic abomasitis and it was checked by occult blood test (Braun 2003). Further author opined that normal colour



Fig. 1. RDA: Right Dorsal abdomen of cattle at 10-13<sup>th</sup> ICS - Heterogeneous hyper echoic content, echogenic abomasal folds with gas cap due to reverberation.

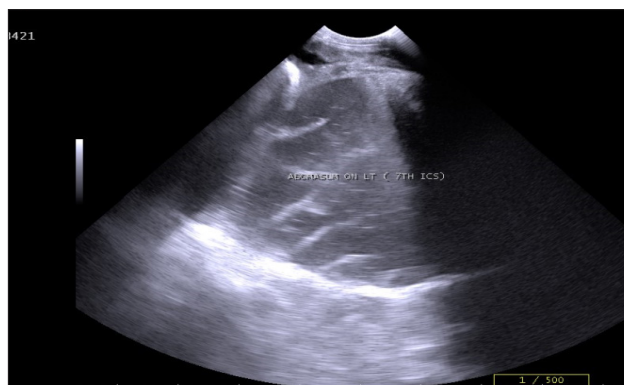


Fig. 2. LDA: Left abdomen of cattle at 7<sup>th</sup> ICS - Heterogeneous content along with hyper echoic abomasal folds.



Fig. 3. Abomasal bloat: Ventral abdomen of calf - Heterogeneous hyper echoic content.



Fig. 4. Abomasal impaction: Left mid abdomen of cattle at 7-9<sup>th</sup> ICS - Homogenous hyper echoic content.

of abomasal fluid was olive green to grey with a sour smell at pH of 1.38-4.5. Bairwa *et al.* (2022) found abomasal pH of 2 and absence of protozoa on microscopic examination confirming abomasal fluid.

In the present study, out of 36 cases, 11 cases showed growth in microbial culture. From that five types of microorganisms were isolated which includes *Staphylococcus thermophiles* in 5 cases, *Bacillus thermophiles* in 2 cases, *Candida* spp. in 2 cases, and *Pseudomonas* spp. and *Fusobacterium* spp. in 1 case in each. Among this *Candida* spp. and *Fusobacterium* were isolated from abomasal ulcer cases. Especially, *Candida* spp. were isolated from the calves that were fed with large quantity of milk. Jelinski *et al.* (1995) reported *Clostridium perfringens* type A, *Camphylobacter jejuni* and *Streptococcus* spp. in abomasal fluid of calves with abomasal ulcer. Disturbance in the normal microbes by use of antimicrobials, could favor the growth of these microorganisms. Similarly, administration of steroids and stress could promote fungal infection.

Cattle with a history of a high-grain diet during the early postpartum period and poor or non-responsiveness to gastrointestinal disorder treatments should be evaluated for potential abomasal disorders. Abdominal ultrasonography was effective in diagnosing abomasal displacement, its utility has limited in detecting non-perforating abomasal ulcers. Assessing serum levels of calcium, chloride,

potassium, and rumen chloride could help to determine the severity of the condition. Additionally, elevated serum pepsinogen serves as a reliable indicator of abomasal inflammation. This comprehensive diagnostic approach supports early detection and timely initiation of treatment/management protocols for abomasal disorders in cattle.

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