



Review Article

Disorders of forestomach in large ruminants: A review

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Abstract

In countries like India where growth of human population is a major problem, livestock products are major source of nutrition to fulfil the demands of this large growing population. Disorder affecting the forestomach of large ruminants pose a significant challenge to livestock productivity. This review presents important findings on understanding ruminal disorder, diagnostic techniques and their treatment of common clinical conditions like ruminal acidosis, bloat, ruminal impaction, reticulo-peritonitis, and predisposing factors such as nutrition, management practices and environmental factors have been explained. The currently available diagnostic techniques, advanced imaging laboratory techniques, their timely assessment have been discussed in detail. The diagnosis of the disorders through various diagnostic methods and subsequent treatment methods, dietary adjustments and precautions to be taken to protect the livestock from the effects of these disorders have been described. Animal welfare requires the availability of animal nutrition for clinical solution to diseases and a holistic approach towards treatment of disease.

Keywords advanced imaging techniques, disorder, forestomach

Introduction

Disorders of forestomach which affect large ruminants including cattle and buffalo, affect the productivity of the animals which reduces the daily income of the farmers considerably. Agriculture and animal husbandry are the main sources of income for the farmers in villages and it contributes a major portion of the GDP of India. Digestive disorders are the most common problems in large ruminants where the main causes are changes in animal feed, poor animal feed, high concentrate feeding, ruminal dysfunction, etc. According to Kumar et al., [1] forestomach disorders are the most commonly reported problems in dairy animals and are prominent in the field of large animal internal medicine. Erdman [2] reported that Simple indigestion results from forestomach atony and presents clinically with anorexia, absence of ruminal movements, and constipation. It typically occurs due to dietary changes, ingestion of toxic plants, or rapid consumption of large amounts of feed. The most prevalent forestomach disorder in large ruminants is rumen acidosis, which is characterized by an imbalance in ruminal pH due to excessive fermentation of readily fermentable carbohydrates. According to Carter and Grovum [3], ruminal acidosis is categorized as a metabolic disorder in

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cattle. This condition can result in suboptimal microbial activity, impaired nutrient utilization, and metabolic disturbances, ultimately impacting animal health and productivity. Bloat is a continuing hazard to cattlemen [4]. Additionally, bloat is caused by the accumulation of gas within the rumen, and poses a significant challenge, particularly in animals consuming rapidly fermentable forages or legumes.

In India, Simple indigestion is a common gastrointestinal disease affecting most large ruminants such as cattle and buffalo in their lifetime. Simple indigestion can result from factors such as ingestion of indigestible roughage, particularly when protein intake is low, consuming moldy, overheated, or frosted feed, excessive intake of grain and concentrate, and prolonged use of high doses of oral antimicrobials. According to George et al. [5] in field conditions, indigestion occurs when the animal gets a higher amount of concentrate or grains and they cannot digest adequately.

Ruminal acidosis is commonly occurring in dairy farms which are managed intensively. It occurs due to sudden intake of lethal doses of carbohydrate-loaded feeds such as grains. It occurs commonly in feedlot cattle, animals fed on low energy ration, due to breakdown in feed mill, fiber deficient ration. It predisposes animals to ruminal pH imbalances and metabolic disturbances, leading to subclinical or clinical acidosis. Nourishing with a superior energy concentrate diet increases the uncertainty of subacute ruminal acidosis (SARA) [6].

Bloat occurs in grazing animals when the animal grazes on large quantities of legumes like lucerne and clover. Ruminants carry a large population of active microorganisms that generate large volumes of gas during the process of breakdown; gas is either expelled or transited through the gastrointestinal tract. It occurs when the eructation of gas is interfered. Pressure causes edema on the left side of the body. According to Wang et al., [7] based on the current scientific understanding and production experience, there are two main opinions regarding the causes of rumen bloat induced by feeding high-concentrate diets. One theory attributes to excessive and rapid gas production in the rumen, while the other links to the formation of significant quantities of stable foams in the rumen.

Traumatic reticuloperitonitis (TRP) is the condition in which an animal ingests metalware objects such as rivets, wires, or pieces of metal while grazing or consuming contaminated feed. According to Ahmed et al., [8] TRP remains one of the most significant internal disorders of cattle as they are not very selective and cannot distinguish metallic objects in feed. TRP is a relatively common reason for abdominal surgery in both species. The importance of this disease is not only due to its higher prevalence among other digestive disorders but also due to the difficulty in early prediction and the difficulty in evaluation of its sequelae by physical examination [9].

Ruminal impaction is a clinical condition characterized by the enlargement of the rumen due to the obstruction of ingesta flow by accumulated indigestible external objects such as wires, rivets, plastic materials, trichobezoars, or phytobezoars. This obstruction leads to the passage of scanty or no feces [10-12]. Vagal indigestion or Hoflund syndrome is characterized by changes in the motility pattern of the fore stomach as well as abomasum and occurs due to vagus nerve impairment in adult dairy cows and less frequently in beef cattle, buffaloes, calves [13-18].

This review aims to synthesize current knowledge and evidence-based practice about forestomach disorders in large ruminants, providing valuable insights for veterinarians, livestock producers, and stakeholders involved in animal health and production management.

Epidemiology of forestomach disorders of ruminants in India

In India, forestomach disorders in large ruminants, particularly cattle and buffalo, are prevalent and pose significant economic challenges to the livestock industry. Ruminal disorders indeed have significant implications for animal health and productivity. They can impact a large population of animals and cause substantial losses in both production and treatment costs. Preventive measures or early detection are crucial in managing these disorders effectively [19-20]. The exact incidence rates of these disorders vary across regions and production systems but are generally considered due to

factors such as improper feeding practices, limited access to veterinary care, and environmental stressors. Gastrointestinal disorders may be classified into four major categories disorders of mouth, pharynx, and oesophagus; disorders of forestomach; abomasal disorders and intestinal disorders. According to Morwal et al., [21] forestomach disorders are very common in buffaloes but their diagnosis is always challenging to veterinarians. Whatever happens in the stomach of buffalo ultimately animals will suffer. Morwal et al., [22] suggested apart from stomach disturbances, many other factors play an important role in forestomach disorder such as pregnancy, calving status, dystocia, fever, abdominal pain, and milk production. According to Sharma et al., [23], more than 15% of mortality in milch and beef animals is due to abomasal diseases and resulting peritonitis. Hussain and Uppal [24] reported that the increase in the occurrence of forestomach disorders is mainly due to changes in cropping, livestock production, and feeding routines.

Etiology of forestomach diseases in large ruminants

The etiology of forestomach diseases is due to some infectious agent or dietary origin [Table 1]. Dietary imbalances and management-related factors play important etiological considerations. The forestomach of ruminants includes three major compartments rumen, reticulum, and omasum. These compartments play an important role in digesting fibrous plant material through fermentation.

Table 1. Etiology of forestomach disorders

S.N.	Disorders	Etiology
1	Simple Indigestion	Excessive intake of feed rich in grain and silage, low quality of roughage, sudden change in animal fodder.
2	Ruminal acidosis	Sudden ingestion of large quantities of highly fermentable carbohydrate
3	Ruminal Impaction	Foreign body ingestion, low-quality feed intake
4	Ruminal tympany (Bloat)	Ingestion of ballooning fodder or disrupt belching mechanism
5	Traumatic Reticuloperitonitis	Reticular perforation by a metallic foreign body such as rivets and pieces of wires
6	Vagus indigestion	Adhesion involving the reticulum due to TRP and accumulation of abdominal fluid due to failure of moving of ingesta from reticulorumen or abomasum.
7	Traumatic pericarditis	Pericardial sac perfusion by foreign object originating from reticulum
8	Diaphragmatic hernia	Perforation of the diaphragm by metal objects such as rivets and pieces of wires
9	Omasal Impaction	Long fiber content, Inadequate chewing, low water intake, reduced omasal motility, toxicity, intestinal obstruction.

Major clinical findings of diseases

There are several clinical findings related to the different forestomach disorders (Table 2).

Diagnosis

Diagnostic confirmation of simple indigestion is associated with spontaneous recovery. The diagnosis of forestomach diseases in ruminants involves a combination of clinical examination, history-taking, laboratory tests, and diagnostic imaging. Here are some common methods used for diagnosing forestomach diseases in ruminants: Wilson and Ferguson [25] suggested observations during rectal palpation indicate that the rumen is distended with either gas or froth, which fills the entire left abdomen and displaces the left kidney to the right of the midline.



Table 2. Major clinical findings of forestomach disorders

S.N.	Disorders	Major clinical findings
1	Simple Indigestion	Loss of appetite, reduced milk yield, absence of cud chewing (rumination), decreased or absent reticulospinal contractions, normal vital signs
2	Ruminal acidosis	Loss of appetite, stress, dehydration, cessation of normal rumen contractions and digestion, sweet sour odor of feces with profuse diarrhea, weakness, ataxia leading to recumbency, fluid splashing sounds audible on auscultation, laminitis.
3	Ruminal Impaction	Anorexia, weight loss, foamy salivation, emaciation, abdominal distension, recumbency.
4	Ruminal tympany (Bloat)	Bulging of the left abdomen, extreme distress, dyspnea, protrusion of tongue, when passing a stomach tube in frothy bloat, it shows froth and the inability to expel a considerable volume of gas, in secondary free gas bloat, release of the large quantity of gas.
5	Traumatic Reticuloperitonitis	Sudden anorexia with decreased milk yield, fever, ruminal stasis, localized pain in the abdomen, and diffuse peritonitis.
6	Vagus Indigestion	Distension of the abdomen gradually especially the left upper portion, inappetence to anorexia and scanty feces, Papple-shaped abdomen, hypomotility and hypermotility of rumen
7	Traumatic Pericarditis	Stress, toxemia, fever, inappetence, jugular vein engorgement, brisket edema, muffled heart sounds, and pericardial frictional rub on auscultation.
8	Diaphragmatic hernia	Dyspnea, anorexia, tachycardia, reluctance to move, signs of discomfort or pain, swelling or bulging of the flanks, recurrent tympany.
9	Omasal Impaction	Anorexia, cessation of defecation, subacute abdominal pain

History taking

1. Clinical signs- inquire about the animal symptoms such as reduced appetite, weight loss, diarrhea, abnormal posture, reduction in milk yield
2. Symptoms duration- how long does the animal show the signs of illness?
3. Diet and feeding practice- details about the animal diet, feeding practices followed, and recent changes in diet and management practices.
4. Previous medical history
5. Herd health status

Physical examination

Examine the animal properly. Physical examination of the animal including general body condition, measuring the vital signs (temperature, heart rate, and respiration rate), examination of mucus membrane, rumen auscultation, rumen fluid examination, per rectal examination.

Special examination

Other than the physical examination, special examination is also being done for the diagnosis of disorders (Table 3).

Treatment

Simple indigestion

Most cases of simple indigestion recover voluntarily. Feeding good quality hay to the animal improves digestion procedure. Rumenoatorics: containing nux vomica, ginger, and tartar emetic orally. Parasympathomimetic: Ipratropium, physostigmine, atropine, and neostigmine are used. Neostigmine @ 2.5 mg/45 kg BW I/M can be used. Metoclopramide: for hypomotility linked with vagal nerve damage. Epsom salts 0.5 to 1.0 kg/ adult cow. Magnesium hydroxide @ 400g/ adult cow



in acidic conditions. In rumen alkalinity acetic acid or vinegar can be given @ 5 to 10 liters. George et al., [5] reported that the combination of chlorpheniramine maleate and B complex vitamins can be effectively used in the clinical supervision of simple indigestion of cattle. Avoiding rapid changes in diet composition and maintaining a consistent feeding schedule to minimize disruptions in rumen function.

Table 3. Special examination for diagnosis of disorders

S.N.	Fore stomach disorder	Special examination
1	Rumen acidosis	Rumen fluid examination
2	Bloat	Tympany on percussion and signs of respiratory distress
3	TRP	"Ping" sound on percussion of the thorax
4	Rumen Impaction	Per rectal examination revealed hard feces balls

Pain management

Administering analgesics (NSAIDs) to alleviate pain and reduce swelling associated with ruminal acidosis. Providing supportive care, such as rumen massage or lavage, relieves bloat and facilitates gas expulsion from the rumen.

Ruminal acidosis

Managing acidosis is crucial in preventing laminitis, especially in high-producing dairy herds aiming to maximize energy intake. These herds often face challenges with subclinical acidosis and subsequent laminitis due to their high-energy diets. Control of feeding and husbandry practices can be implemented to reduce the occurrence of disease [26]. Acidosis remains a major challenge for milking and feedlot cattle production globally. It is caused by the feeding of diets high in easily fermentable carbohydrates and low in effective fiber such as grains which lead to the production of organic acids that exceed the buffering capacity of the rumen [27-28].

Immediate veterinary attention

If ruminal acidosis is suspected, it's crucial to seek immediate veterinary attention for proper diagnosis and treatment. A veterinarian will conduct a physical examination, which may include abdominal palpation, auscultation of the rumen, and possibly diagnostic tests such as rumen fluid analysis to assess the pH and fermentation profile.

Rumen Buffering

Buffering agents can help raise the pH of the rumen and neutralize excess acids. Commonly used buffering agents include sodium bicarbonate (baking soda) and magnesium oxide. Animals are triaged to assess the need for therapeutic interventions such as rumen lavage or rumenotomy while also being provided with palatable grass hay and restricted water access. Selected animals are treated with at least 5 liters of fresh rumen fluid to correct ruminal and systemic acidosis using alkalizing agents, such as magnesium hydroxide orally, parenterally with 1.3% to 8.4% sodium bicarbonate or ringer's solution depending upon severity. Severely affected cases should receive parenteral antibiotics like procaine Penicillin G or Oxytetracycline to treat presumed rumenitis and prevent liver abscess development. Additionally, vitamin B is administered to aid in metabolizing L-lactate [29].

Bloat

It can be classified into frothy bloat or free-gas bloat, each requiring different treatment approaches. The severity of ruminal tympany varies depending on the completeness of the obstruction, ranging from mild to severe clinical signs. Diseases affecting the rumen wall can disrupt normal motility mechanically [30].

First aid emergency measures



Emergency rumenotomy in severe cases with gross ruminal distention. An incision of about 10-20 cm in length over the LPF through the skin, abdominal wall muscles, and directly into the ruminal cavity. For feedlot bloat antifoaming agents such as nontoxic oil, and non-biodegradable oil- 250- 500 ml per animal is used. Administer detergent such as dioctyl sodium sulfosuccinate orally. Synthetic surfactant like polaxalene at 25-50 g is recommended orally Oral administration of alcohol ethoxylate which is more efficient and rapid than oil.

TRP

Cattle are administered orally with the strongest magnet feasible, verified by a compass, to prevent the piercing of foreign objects. Additionally, procaine penicillin at a dose of 22,000 U/kg BW is administered intramuscularly daily for a minimum of 5 days while oxytetracycline is given intravenously at a dosage of 16.5 mg/kg daily for at least 5 days. To minimize the movement, animals are confined to small stalls. If animals won't respond after 3 days of medical treatment, cattle of higher economic value may undergo rumenotomy and removal of foreign bodies [29].

Vagus indigestion

The vagus nerve is not only found in the head area but also projects into the thoracic and abdominal cavities, where it branches, forming a visceral plexus [31]. Administration of liquid paraffin 2.5 liters orally for 3 to 5 days. Orally administration of dioctyl sodium sulfosuccinate. Injection of vitamin B1 (500mg) daily I/M. Infusion of magnesium sulfate into the abomasum 5% dextrose saline 2 to 5 liters daily i/v drip till recovery.

Ruminal impaction

Principle treatment is evacuating the ruminal contents by lavage or rumenotomy [32]. Use of saline purgatives like magnesium sulfate. Correction of ruminal pH by magnesium carbonate magnesium oxide or sodium bicarbonate. Oral antacids may be useful. Use of oral antibiotics such as Penicillin 50-100 lakh IU, tetracycline 8 to 10 gm, ampicillin 5 to 10 gm, erythromycin 10 to 20 gm dissolved in 5 to 10 liters of water. In the Acute stage, liver protective agents are suggested ex- amino acids and vitamin B12. Ruminal massage, rumenotorics.

Diaphragmatic hernia

Surgical procedures include rumenotomy and herniorrhaphy. Herniorrhaphy should be performed at an interval of 48 hours after rumenotomy. The first step of treatment is laparo-rumenotomy. 3/4th content of rumen should be evacuated. Before the closure of rumen, fresh rumen fluid from healthy animals should be transplanted to revive the rumen flora. Before hernial repair rumen evacuation and assisted ventilation is required during herniorrhaphy. The animal is kept off feed for 48 hours following ruminal evacuation, during this period animal is kept rehydrated with adequate fluid therapy.

Herniorrhaphy

Half an hour before herniorrhaphy, Prednisolone acetate (1.5-3mg/Kg) is administered i/m to prevent intraoperative shock. The animal is positioned in lateral recumbency and fluid therapy should be given Anesthesia is induced by various combinations A positive pressure ventilator is then connected to the endotracheal tube. Anesthesia is maintained with 2% or 4% halothane or isoflurane. Abdominal and thoracic approaches are the most common approaches for diaphragmatic herniorrhaphy.

Trans thoracic approach

In the transthoracic approach, thoracotomy on the right or left side is performed based on the location of the hernia. A 25 cm long cutaneous incision is made midway between the 7th rib and



extended ventrally to the costochondral junction. Access to the thoracic cavity is gained through a rib resection technique. Upon entering the thoracic cavity, the herniated reticulum is identified and adhesions with the lungs, pericardium, and pleura are meticulously separated using blunt dissection. The reticulum is then freed from the hernial ring by disrupting the adhesions with blunt dissection. The reticulum is then pushed back into the abdominal cavity and then the ring is closed using a simple continuous suture technique with non-absorbable suture material. 5 to 7 days of critical postoperative care is necessary after the whole procedure.

Conclusion

The Forestomach disorders of large ruminants pose significant challenges to animal productivity and health. The early diagnosis of these disorders becomes necessary for overcoming this situation. The farmer must know what should be fed to the animal. The forestomach disorders like acidosis and simple indigestion are the most common conditions in the field. So, the education and awareness of such kinds of disorders and their prevention as well as control strategies should be taught to the farmers at the village level. The proper diagnostic facilities and medicine supply should be made at village hospitals and polyclinics. By implementing appropriate preventive measures and providing timely treatment, veterinarians and livestock producers can mitigate the impact of these disorders and promote the well-being of affected animals.

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