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Bovine intestinal obstruction: A review

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Abstract
Bovine gastro-intestinal obstructive disorders can be classified into fore-stomach, abomasal and intestinal (small and large) disorders. Animals suffering from intestinal disorders generally show non-specific clinical signs anorexia, lethargy, dehydration, abdominal pain, tachycardia and lack of defecation or the passage of dark fecal blood and mucus, acid-base imbalance and death if physical obstruction remains untreated. Calves less than 2 months of age were found to be at greater risk of developing small intestinal intussusception than that of adult cattle. Partial or complete absence of feces, dilatation of the intestine cranial to the obstruction with fluid and gas, acute abdominal pain and a hypochloremic, hypokalemic metabolic alkalosis and dehydration are the findings of intestinal obstruction. Depression, loss of responsiveness, halitosis, dehydration with dry mucosa, colic (treading and stretching out, kicking at abdomen, lying on ground), retc. hing and bilateral lower abdominal distention at later stages. Cows with caecal dilatation may be asymptomatic, and the cecal distention may be detected during rectal examination. Hemoconcentration, a mild left shift and an inverted neutrophil-to-Iymphocyte ratio are common in cases of intussusception. A sandwich like appearance is seen during ultrasonography in case of intestinal intussusception especially jejuno-jejunal when viewed longitudinally. Transabdominal or transrectal ultrasonographic findings of intussusception may reveal target lesion. Conservative treatment involves correction of fluid imbalances and appropriate antibiotic therapy. Surgical correction is the choice of treatment in animals suffering from physical obstructions, intussusception, small intestinal volvulus, gut tie, abdominal herniation of the intestine.

Keywords: Bovine, intestinal, hemoconcentration, transabdominal, obstruction

Introduction
Gastro-intestinal disorders are common and have enormous economic importance in bovines. Bovine gastro-intestinal obstructive disorders can be classified into fore-stomach, abomasal and intestinal (small and large) disorders. Animals suffering from intestinal disorders generally show non-specific clinical signs anorexia, lethargy, dehydration, abdominal pain, tachycardia and lack of defecation or the passage of dark fecal blood and mucus, acid-base imbalance and death if physical obstruction remains untreated. Cessation of defecation could result from obstructive lesions present anywhere in the small or large intestines, so it is important to accurately localize the nature and site of the lesion (Kumar *et al*. 2015, Singh *et al.* 2019, Sodhi *et al*. 2019) [30, 48, 52]. Abdominal ultrasonography has been proved to be reliable diagnostic aid for abdominal affections in bovines (Mohindroo *et al.* 2020) [36]. Abomasal displacement and reticuloperitonitis are the most common surgical disorders of stomach region, and caecal dilatation of the large instestine of cattle (Anderson *et al*. 2005) [3]. Intussusception (Kumar *et al*. 2015) [30] and volvulus are the commonest causes of the physical occlusion of the intestinal lumen in cattle. The physical obstruction need to be differentiated from a functional obstruction due to local or general paralytic ileus in which the intestinal lumen remains physically patent and filled with contents but no passage of ingesta through it. The mechanical obstruction like phytobezoars (Dharmaceelan *et al.* 2015) [17], strangulation due to gut-tie (Sodhi *et al*. 2019) [52], fecoliths (Singh *et al.* 2017a, Singh *et al.* 2017b) [49] can also ileus of the part of intestines cranial to obstruction. Majority of the surgical maladies of the bovine gastrointestinal tract like ruminal impaction, diaphragmatic hernia, traumatic reticulitis, abomasal impaction, intussusception, caecal dilatation etc. result from multifactorial etiology (Makhdoomi *et al.* 1995) [33]. Therefore, in many cases, decision making is not straight forward. This review discusses predisposing factors, diagnostic and therapeutic aspects of intestinal obstruction in cows and buffaloes.

Signalment/incidence/etiology

Cows in periparturient period, particularly during the initial 2 months of calving have been reported to be most vulnerable for development of caecal dilatation as high milk yield demands consumption of more concentrates that leads to increased production of volatile fatty acids (VFA's) (Fubini *et al.* 1990) [22]. The high level of VFA's produce atony and subsequent accumulation of gasses are proposed to be associated with cecal dilatation and further dislocation (Fubini *et al.* 1990) [22]. Also winter season has been found to be an important predisposing factor for the occurrence of caecal dilatation (Fubini *et al.* 1990) [22]. However, Startlet *et al.* (2008) no impact of season on the occurrence of intussusception.

Braun *et al.* (1993) [13] reported clinical signs, blood and rumen fluid changes, laparotomy findings, treatment and course of disease in 23 cows with obstruction or compression of the duodenum. The duodenum was obstructed by a phytobezoar (n = 14), by a blood clot (n = 1) or compressed by and adhered to a liver abscess (n = 8). Constable *et al.* (1997) [15] studied 336 cattle suffering with intussusception. Out of these 281 had small intestinal, 7 had ileocolic, 12 had cecocolic, and 36 had colocolic intussusceptions. Sex and season predisposition were not found to be associated with intussusceptions, however, calves less than 2 months of age were found to be at greater risk of developing small intestinal intussusception than that of adult cattle.

Saini and Mahajan (2001) [46] reported an 8 year old buffalo which had intestinal obstruction due to fecolith that was enclosing a sharp metallic foreign body about 6.5 cms long which was protruding from the intact intestinal wall on one side. Fecolith and foreign body were removed by enterotomy and buffalo recoverd uneventually. Abutarbush and Naylor (2006) [1] did a retrospective study on small intestine obstruction caused by a trichobezoar in 15 cattle. Trichobezoars were more commonly recorded in young cattle. Braun *et al.* (2011b) [10] reported rare case of duodenal ileus caused by a calf feeding nipple in a cow. The main clinical signs were complete anorexia, ruminal tympany, decreased fecal output and abomasal reflex syndrome. Hasunuma *et al.* (2011) [24] studied on 5 cases of acute colic following feeding of Napier grass roughage in Japanese black cows. Necropsy revealed intestinal obstruction due to phytobezoar derived from Napier grass, fed mainly to the cattle as roughage. Dharmaceelan *et al.* (2012) [18] observed overall incidence of gastro-intestinal obstruction was higher in adult animals of age more than 5 years, whereas, intestinal obstruction was more in animals below 2 years of age. Kushwaha *et al.* (2012) [32] observed higher incidence of intussusception was recorded in young cows of less than 2 years of age and majority of the cases were presented in summer season. Ubiali *et al.* (2012) [59] reported epidemiology, clinical and pathological picture of intestinal obstruction in cattle that grazed phytobezoars in paddocks with a predominance of *Stylosanthes* sp. at least for 60 days.

Dharmaceelan *et al.* (2018) [19] noticed distended abdomen in 79.48% animals with intestinal obstruction and this could be related to development of tympany, impaction, reduced motility and distension proximal to the site of obstruction of intestine. The percentage of fluid splashing sound in animals diagnosed for intestinal obstruction was 84.61% to that of 21.21% in cases of stomach obstruction. Severe dehydration was noticed in the cases with intestinal obstruction. The incidence of intestinal obstruction was higher in monsoon season compared to summer and winter.

Pathogenesis

Physical obstruction

Physical obstruction of the small intestines of cattle can occur from both intra luminal or extraluminal obstruction which results in the partial or complete absence of feces, dilatation of the intestine cranial to the obstruction with fluid and gas, acute abdominal pain and a hypochloremic, hypokalemic metabolic alkalosis and dehydration. The intraluminal intestinal obstruction can occur at any portion of gastrointestinal tract including as proximal as pyloric antrum (Cebra *et al.* 1996) [14] to as caudal as large colon distal to caecum due to phytobezoar (Braun *et al.* 1993; Hasunuma *et al.* 2011; Ubiali *et al.* 2012; Pearson H and Pinset 1977) [13, 24, 43, 59], trichobezoar (Anderson *et al*. 2005; Abutarbush and Naylor 2006; Pearson H *et al.* 1973) [1, 3, 42], blood clot due to haemorrhagic bowel syndrome (Braun *et al.* 1993; Denison *et al.* 2002) [13], intraluminal parasite (*Toxocara vitulorum*) (Van der steen *et al.* 2014) [61], foreign bodies like calf feeding nipple or sharp penetrating metallic foreign body (Braun *et al.* 2011; Saini and Mahajan 2001) [10, 46], enteroliths (Pearson H 1973; Pearson H and Pinset 1977) [42, 43]. or extraluminal causes like compression due to space occupying lesion like liver abscess (Braun *et al.* 1993) [13], omental herniation causing incarceration to jejunal loops (Pardon *et al.* 2009) [41] and gut tie in male castrated cattle (Radositis *et al.* 2000), intussusception, volvulus, strangulations (Smith BP *et al.* 2014) [54]. The alkalosis results from small-intestinal and abomasal reflux into the rumen, with chloride and hydrogen ion sequestration in the abomasum (Braun *et al.* 1993; Tyagi and Singh 2006) [13, 35, 55]. Ileus of the small intestines is one of the most common consequences of strangulation, intussusception and volvulus of the intestine, which can rapidly lead to impaired circulation, damage of the intestinal barrier and endotoxaemia (Pearson and Pinsent, 1977; Anderson *et al*. 1993; Braun *et al.* 1995) [4, 9, 43] and can include any part of bowel resulting in obstruction, which leads to distension and hypomotile cranial part, causing the accumulation of intestinal secretions and ingested fluids produces intestinal distension and increasing pain (Snyder and Spier 1996) [56]. Clinical signs of ileal impaction in Swiss Braunvieh cows include anorexia, a sudden decrease in milk production, and some evidence of colic, such as moving weight from leg to leg and occasional kicking at the abdomen. The ventral aspect of abdomen was enlarged and pear-shaped, and a tense abdominal wall was present in some cows (Nuss *et al.* 2006) [40]. The feces in the rectum may be reduced in amount or there may be none. On rectal palpation, dilated loops of both small and large intestine are usually palpable. On laparotomy, the impaction was situated at the ileocecal valve, and the ileum proximal to ileocecal junction was impacted with ingesta for up to 15 cm in length.

Volvulus and intussusception

Volvulus of the small intestine is a rotation of the entire small intestine, with or without the cecum and spiral colon, or of only the distal third of the jejunum and the proximal portion of the ileum around its mesenteric axis. The volvulus results in intestinal distension, vascular compromise, intestinal necrosis and eventually death unless surgically corrected (Anderson *et al.* 2005) [3]. The invagination of one segment of the intestine into the lumen of an adjacent segment of the intestine is known as intussusception. The invaginated portion

is known as Intussusceptum and the receiving part of intestine is known as Intussuscepiens. Jejunojejunal intussusception is the most common form in cattle, although isolated cases of ileocecal), cecocolic, colocolic intussusception (Constable P D *et al.* 1997) [15] and ileocecocolic (Lee *et al.* 2013) [33] had been reported. The intussusception is usually single, but doubles do occur. Intussusception may be caused by a variety of factors, including enteritis, intestinal parasitism, abrupt dietary changes, mural granuloma or abscess, intestinal neoplasia, especially adenocarcinoma, mural hematoma, and the use of drugs that affect intestinal motility. Any focal disturbance of intestinal motility may facilitate the invagination of an orad segment into an aborad segment of intestine (Archer RM *et al.* 1988; Anderson *et al*. 2005) [3, 5]. There have been cases of cattle surviving after sloughing of an intussusceptum, but these are uncommon. If surgical correction is not performed, death normally occurs 5-8 days after the onset of clinical findings.

Clinical signs and examination findings

Depression, loss of responsiveness, halitosis, dehydration with dry mucosa, colic (treading and stretching out, kicking at abdomen, lying on ground), retching and bilateral lower abdominal distention at later stages. Cows with caecal dilatation may be asymptomatic, and the cecal distention may be detected during rectal examination. (Duelke and Whitlock, 1976) [20]. Rectal examination may help in subjective assessment of volvulus and intussusception but could not confirm it. Animals suffering from intestinal volvulus has scanty mucoid feces, distended small intestinal loops in pelvic inlet with tight bands coursing dorsoventrally in midabdomen (Anderson *et al*. 1993) [4]. Similarly, Sodhi *et al.* (2019) [52] recorded a tense fold of mesentry and empty rectum on per-rectal examination in a cow suffering from gut-tie. A tympanic resonant ping at the right paralumbar fossa has also been reported as diagnostic for caecal dilatation (Green and Husband 1996, Mulon and Desrochers 2005, Mesari and Modic 2007) [23, 35, 38]. Multiple dilated intestinal loops in pelvic cavity on rectal palpation, though a non-specific clinical feature of intestinal obstruction due to any cause (Singh *et al.* 2017a and Singh *et al.* 2017b) [49], could be a diagnostic feature of intestinal volvulus as well (Hussain *et al.*, 2014) [25]. Animals suffering from intususception may show anorexia, colic, scanty mucoid blood tinched faeces and rectal palpation of a sausage shaped mass along with mesentric pull (Kumar *et al*. 2015, Vishnugurubaran *et al* 2015) [30, 62].

Clinical pathology

Clinico-pathologic findings are generally nonspecific and of limited assistance in making a diagnosis or assessing prognosis preoperatively.

Haemato-biochemistry

Hypochloremia, hyponatremia, azotemia, and hyperglycemia are commonly observed in intestinal obstruction (Whitlock, 1976) [20]. Hemoconcentration, a mild left shift and an inverted neutrophil-to-Iymphocyte ratio are common in cases of intussusception. Anderson *et al*. 1993 [4] found high mean value of serum potassium level with lower mean value of preoperative venous blood pH and mean base excess in the 35 cattle suffering from small-intestinal volvulus. The measurement of serum lactate level in critically ill patient has been reported as useful prognostic indicator and decisive tool to decide line of treatment (Allen and Holm 2008) [2]. Animals suffering from GIT anomalies caudal to omasum have inflammatory leukogram with neutrophilia and acidic rumen pH with hyperchloremia in addition to hypocalcemia, hypokalemia and hypochloremia which was the only finding in the animals with GIT anomalies cranial to omasum (Sahoo *et al.* 2019) [46].

Peritoneal fluid examination

Increased glucose and urea nitrogen contents of the peritoneal fluid as major changes in an experimental model of strangulated ileal obstruction in buffaloes (Krishnamurthy *et al*, 1980) [29]. Archer *et al*. (1988) [5] found that cows suffering from intussusception had increased peritoneal fluid opaque red in colour with a nucleated cell count of 11000/µl, total proteins 6.6 g/dl and red blood cells count 1.26×10^6 /µl. Singh and Patil (2001) [50] reported that the biochemical profile of peritoneal fluid may reflect alterations in the plasma and concluded that variations in peritoneal fluid constituents may point to a systemic rather than a disease of the peritoneum. Mohan *et al.* (2006) [36] observed alterations in majority of the biochemical parameters of peritoneal fluid reflecting a systemic change; however, cytological examination of peritoneal fluid showed no abnormal changes while a high rumen chloride value was recorded. Braun *et al.* (1988) [8] examined peritoneal fluid in cows suffering from suppurative peritonitis and found that it was exudative having increased specific gravity and total solids with a predominance of neutrophilic leukocytosis.

Ultrasonographic examination

Abdominal ultrasonography is a very beneficiary tool for the veterinary practitioner especially in large animal practice to establish diagnosis along with its differentials as the cause of intraluminal obstruction is very occasionally palpable during per-rectal examination except for few or more distended intestinal loops (Anderson *et al*. 2005) [3]. In combination with other diagnostic approaches, ultrasonography can help us differentiating various abdominal disorders in bovines like foreign body syndrome, abomasal displacement, small intestine ileus, caecal dilatation and displacement (Braun *et al* 2005) [11]. The difference can be made between duodenum and other part of small intestine easily and can also be differentiated from the large colon and caecum on the topographic basis during ultrasonographic examination (Braun *et al* 2009) [12]. A sandwich like appearance is seen during ultrasonography in case of intestinal intussusception especially jejuno-jejunal when viewed longitudinally (Pravettoni *et al.* 2009; Tharwat 2011) [44, 57]. Transabdominal or transrectal ultrasonographic findings of intussusception revealed Byll's eye lesion or Target lesion (Anderson *et al*. 2005; Imran *et al.* 2011; Kumar *et al*. 2015) [3, 27, 30]. Abdominal ultrasonography can help to identify ileal impaction/ileus as well as can help in differentiating the ileal impaction/ileus from duodenal and jejunal ileus (Braun *et al* 1995) [9]. Intraluminal lesion like blood clots in hemorrhagic bowel syndrome can be seen as echogenic mass of homogeneous consistency within the lumen of intestine (Denison *et al.* 2002). The caecum and large colon can be easily seen at mid paralumbar fossa ultrasonographically, caecum can be seen from mid paralumbar fossa to 11th ICS or last three ribs when distended with spiral colon seen as garland dorsal to the caecum and ventral to the discending colon without hinderance in the visibility of liver (Braun *et al.*

2001; Khalphallah *et al.* 2016) [6, 28]. In addition to detect which structure of GIT is affected ultrasonoghraphy can help us to identify whether the peritonitis is developed or not (Braun *et al.* 2002; Mulon PY & Desrochers A 2005) [7, 38] and can help us judging the better prognosis.

Treatment

Conservative or medicinal treatment

Medicinal treatment in case of intestinal obstruction depends on the severity or degree of extent of pathology involved, presence of necrotic enteritis or not, presence of peritonitis or not and the lactate content of serum and peritoneal fluid. It involves correction of fluid imbalances, appropriate antibiotic therapy, and assessment of intestinal viability are very important considerations for prognostic pint of view (Radositis *et al.* 2000). The successful management of the caecum dilatation in milch cows is reported by oral drenching of ginger, sodium bicarbonate, common salt and magnesium sulphate in warm water combine with swimming (Umakanthan T *et al.* 2003) [60] and successful management of case of caecum dilatation in kangayam bullock medicinally by injecting polyionic fluids along with bethanechol, neostigmine and calcium borogluconate (Ranjitkumar M *et al.* 2017).

Surgical correction and post-operative care

Surgical correction is the choice of treatment in animals suffering from physical obstructions, intussusception, small intestinal volvulus, gut tie, abdominal herniation of the intestine (Radositis *et al.* 2000; Tyagi and Singh 2005). Right side paralumbar fossa celiotomy is the most common surgical approach under paraverterbral nerve block for exploration of the most of abdominal organs especially small and large intestine including caecum as due to presence of greater omentum and short mesentry of small intestine limits the exposure of small intestine in ventral midline approach and presence of rumen in the left side of the abdomen limits the approach to be right flank (Pearson and Pinsent, 1977; Fubini *et al.* 1986; Anderson *et al.* 1993 4; Constable PD *et al.* 1997; Anderson *et al*. 2005; Tyagi and Singh 2005; Mulon, PY & Desrochers A 2005) [3, 15, 21, 38, 43]. Survival rates for correction of volvulus of the entire small intestine and volvulus of distal jejunum and ileum reported had been 44% and 86% respectively. Dairy cattle had better survival rate than beef cattle which is 63% and 22%, respectively (Anderson *et al.* 1993; Radositis *et al.* 2000) [4]. Cattle operated for ileal impaction have better prognosis when the content from ileum is massaged into caecum intraoperatively (Nuss *et al.* 2006) [40]. Resection and anastomosis are also used to treat irreducible intussusceptions. Survival rates for intussusception in cattle were about 50% (Horne MM *et al* 1991) [26]. End-to-end anastomoses are recommended. Make a long abdominal incision to allow for abdominal exploration. Determine the viability of the intestine and the volume of intestine that needs to be respected. Infiltration of lidocaine 2% into the mesentery where it is planned to be resected may decrease the pain of traction. The arcadian mesenteric vessels are ligated using thick absorbable suture material (chromic gut no. 3) using mass ligation as the arcuate vascular network is not as well developed as in horse. The ligation can be done in the overlapping manner. After the mesentery has been ligated and transection has been completed, Doyen intestinal forceps are used to occlude the normal and abnormal bowel lumens. The intussusception and surrounding bowel are then resected and discarded. Transect the intestine with either a scalpel blade or Metzenbaum scissors along the outside of the forceps. The proximal segment of bowel is exteriorized carefully to its maximal length, and the Doyen forceps is removed. Ingesta within the intestine orad to the lesion is ‘‘milked’’ out through the enterectomy site, being careful not to contaminate the incision or abdomen with ingesta. This procedure lessens the severity of postoperative ileus and shortens convalescence. The two segments of intestine are reunited by end-to-end or side-to-side anastomosis with an absorbable suture material (No.2-0 polydioxanone or polyglactin 910) using a simple continuous suture pattern. To avoid purse-string effect on the anastomosis, suture line line should be placed in 3 or 4 overlapping suture manner each one including one-third of the anastomosis (Anderson *et al.* 2005) [3]. An oblique incision (45- to 60-degree angle) across the intestine with the smaller luminal diameter to help correct size disparity. Make the oblique incision such that the antimesenteric border is shorter than the mesenteric border.

Post-operative care

Fluid therapy

Fluid and electrolyte therapy given intravenously may be necessary preoperatively and always post-operatively. Multiple electrolyte solutions or normal saline are effective even though metabolic alkalosis with hypochloremia and hypokalemia may be present. Oral cathartics and laxatives have been suggested, but these may create metabolic alkalosis. (Ogilvie *et al*., 1983) [39]. Antimicrobials pre- and postoperatively are recommended for the control of peritonitis, which is inevitable and NSAIDs have also been used for their anti -inflammatory and antiendotoxic effects (Radositis *et al.* 2000).

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