BRIEF COMMUNICATIONS

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Colonic intussusception in a Holstein calf

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An intussusception is defined as the invagination of one segment of bowel into the lumen of the adjacent distal segment. The invaginated portion of bowel is referred to as the intussusceptum; the segment of bowel into which it is invaginated is termed the intussuscipiens (1,2). Four types of intussusception are recognized in cattle (1). The "enteric" type involves one segment of the small intestine, usually the distal jejunum or the ileum, invaginating into another. With the "ileocecocolic" type, the ileum invaginates into the cecum or into the proximal colon at the cecocolic junction. The "cecocolic" type occurs with invagination of the cecal apex into the proximal colon. Finally, the "colonic" type involves invagination of the proximal colon, or occasionally the spiral colon, into a more distal segment.

The incidence of intussusception in cattle is relatively low, ranging from 0.5-15% of all obstructive gastrointestinal disorders (1,3,4). A 15% incidence was reported in calves presented to the New York State College of Veterinary Medicine Teaching Hospital and necropsy services (4). In contrast, in a retrospective study at the Western College of Veterinary Medicine, there were no cases of intussusception in 51 calves less than two months of age showing signs of abdominal pain or abdominal distension (5).

Manual reduction of a colonic intussusception in a calf has been reported (6). We report herein the successful treatment of a colonic intussusception by resection of the affected nonviable proximal ascending colon and anastomosis of the ascending colon to the spiral colon.

A 55 kg, six-week-old Holstein heifer calf was presented to the Teaching Hospital of the Ontario Veterinary College with a 72 hour history of anorexia, depression, decreased production of feces, intermittent abdominal distension, and mild colic behavior. Treatment on the farm had consisted of drenching with milk and an oral electrolyte solution (Lifeguard, Norden Laboratories, Mississauga, Ontario).

The calf was in fair body condition, depressed, reluctant to walk, and had an apprehensive expression. It maintained a sawhorse stance and had ventral abdominal distension. Physical examination revealed

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a rectal temperature of 39.2°C, a heart rate of 110/minute, and a respiratory rate of 12/minute. Clinical assessment of 5% dehydration was based on skin tent response of the upper eyelid. Oral mucous membranes were pale, with a capillary refill time of two seconds. Abdominal palpation caused increased apprehension and abdominal guarding; however, no visceral distension was palpable. Auscultation of the abdomen revealed intestinal hypomotility. No tympany was elicited on percussion. Fluid splashing sounds were evident on succussion. No feces were passed during the examination period and a digital rectal examination produced only tenacious, fecal-stained mucus.

Based on the history and initial findings on physical examination, a tentative diagnosis of intestinal obstruction was made. Gas accumulation within the rumen and multiple loops of gas-distended intestine were seen on lateral abdominal radiographs. A ventral-dorsal view revealed a large, gas-distended viscus extending from the right abdomen, across the pelvic inlet to the left abdomen, in a U-shaped configuration.

Venous blood gas analysis demonstrated a mild, uncompensated metabolic acidosis (pH = 7.33, pCO_2 = 40.3 mm Hg, HCO_3^- = 20.2 mmol/L, base excess = -4.2 mmol/L). The plasma electrolyte evaluation indicated hyponatremia (Na = 126.8 mmol/L). The hematocrit was 32% and the total plasma protein concentration was 55 g/L. On abdominocentesis, a pale yellow, slightly turbid, free-flowing fluid with a total protein concentration of 32 g/L and a nucleated cell count of 4.12×10^9/L was obtained. The cells consisted of 80% macrophages and 20% well preserved neutrophils. Bacteria were neither seen on cytological examination nor cultured.

Preoperative antibiotic therapy included sodium crystalline penicillin (Glaxo Laboratories, Glaxo Canada Ltd., Toronto, Ontario) (40,000 IU/kg IV) and trimethoprim-sulfadoxine (Borgal, Hoechst Canada Ltd., Montreal, Quebec) (30 mg/kg IV). Anesthesia was induced with valium (Diazepam, Hoffmann La Roche Ltd., Etobicoke, Ontario) (10 mg IV) and ketamine hydrochloride (Rogarsetic, rogar/STB Inc., Pointe Claire, Quebec) (100 mg IV), and maintained on halothane and oxygen using an endotracheal tube and intermittent positive pressure ventilation. Intravenous fluid therapy consisted to an isotonic electrolyte solution (Plasmalyte 148, Travenol Canada Inc., Mississauga, Ontario), bovine plasma, and sodium bicarbonate.
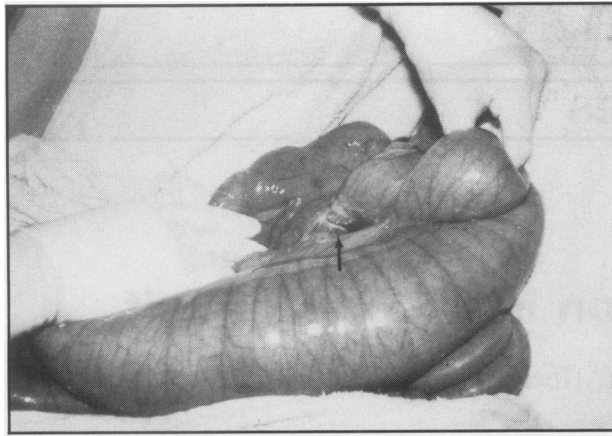
Figure 1. Intussusception (arrow) of the proximal ascending colon.

Abdominal exploration, via a right paralumbar fossa celiotomy, revealed an increased volume of peritoneal fluid containing fibrin, distension of the small intestine and cecum, a flaccid spiral colon, and displacement of the cecal apex to the left craniodorsal quadrant of the abdomen, lateral to the rumen. The displacement was corrected and a typhlotomy performed to evacuate the cecal contents. Upon exteriorization of the cecum and spiral colon, a complete intussusception of the proximal loop of the ascending colon was found (Figure 1). The intussusception was reduced manually, revealing a devitalized and perforated intussusceptum 8 cm in length. A TA-55 stapling instrument (Auto Suture Ltd., Ville St. Laurent, Quebec) was applied perpendicularly to the longitudinal axis of the colon 4 cm proximal to, and 4 cm distal to, the devitalized area. Two blind ends of proximal ascending colon were thus formed by the excision of the intussusceptum and intussuscipiens. Both staple lines were oversewn, using 2-0 polyglactin 910 (Vicryl) in a continuous Cushing pattern. A 5 cm side-to-side anastomosis between the base of the cecum and the first centripetal coil of the spiral colon was performed, using a single application of the GIA intestinal stapling device (Auto Suture Ltd.). This anastomosis was also oversewn. The incised mesocolonic edges were then sutured to the serosa of the colon in order to cover the site of anastomosis and minimize the risk of intestinal adhesions. Following saline lavage, the cecum and colon were repositioned within the abdomen and a routine closure performed.

Postoperative therapy included maintenance (5 mL/kg/h) lactated Ringer's intravenous fluids for 24 h, sodium crystalline penicillin (40,000 IU/kg IV) every 6 h for 24 h, and trimethoprim-sulfadoxine (30 mg/kg IV) every 12 h for seven days. Bloody diarrhea was present 12 h after surgery, with normal feces returning after 36 h. Appetite for milk and oral electrolytes returned within 24 h and the calf's demeanor was good. She was discharged from the clinic five days after surgery. An on-farm recheck 10 weeks postoperatively revealed the calf to be in excellent health and body condition, with no history of postoperative complications.

The use of ancillary diagnostic procedures was instrumental in arriving at the tentative presurgical diagnosis of gastrointestinal obstruction. In adult cattle, examination *per rectum* permits the detection of distended viscera, suggestive of primary gaseous distension or of gaseous and fluid accumulation proximal to an obstructive lesion. On occasion, the lesion itself may be palpated. Examination *per rectum* is not feasible in calves; the use of abdominal radiography is therefore indicated. In this case, the discovery of multiple loops of gas-distended viscera reinforced the suspicion of a gastrointestinal obstruction or of primary "gas colic" as described by Naylor and Bailey (5). Exploratory celiotomy was indicated to identify and to attempt correction of the initiating cause.

A consistent clinical feature of cattle with complete small intestinal intussusception is the gradual development of a hypochloremic, hypokalemic metabolic alkalosis (2). The more proximal the lesion, the more rapid the development of these biochemical abnormalities (2). To my knowledge, there are no reports in the literature describing the biochemical abnormalities associated with cecal or colonic intussusception in cattle, presumably due to the rarity of their occurrence (1,4). Hence the lack of a hypochloremic, hypokalemic metabolic acidosis in this case may have been due to 1) the colonic location of the intussusception, 2) the possibility that calves do not develop biochemical abnormalities similar to those of adults, or 3) that the duration of complete obstruction prior to presentation may have been insufficient to allow the development of these metabolic abnormalities. The hyponatremia observed in this case was attributable to the loss of normal sodium resorption by the colon, compounded by continued loss through the kidneys.

The use of mechanical stapling instrumentation reduced surgical time and allowed colonic resection and anastomosis with minimal contamination

Abdominocentesis is a useful diagnostic aid. In cattle, a nucleated cell count of greater than $6.0 \times 10^9/L$ and total protein content of greater than 30 g/L is consistent with the diagnosis of peritonitis in 80% of cases (7). However, in cases of intussusception, abdominocentesis results may be misleading because the devitalized intussusceptum is enclosed within a relatively healthy intussuscipiens. In this case, the cell count, cytology, and mild elevation of total protein were indicative of a nonseptic inflammatory response.

The enteric type of intussusception is most commonly reported in adult cattle (3,8-10), with the distal jejunum most commonly affected, presumably due to the length and mobility of its mesenteric attachments (1). Ileococcolic, cecocolic, and colonic intussusceptions occur rarely because the mesenteric fat deposits and the ileocecal ligament stabilize the bowel, thereby preventing invagination (1). In contrast, the incidence of intussusception in calves appears more uniformly distributed among the four recognized forms (3,4,6). This is presumably due to the thin, fragile nature of

the mesentery which may be more prone to tearing under tension, thereby allowing increased movement of adjacent segments of bowel (1).

An age predilection for intussusception has not been reported in cattle. A failure to diagnose the problem early, and the low economic value of calves, may explain the lack of reported clinical cases. In one study, 83% of bovine cases of intussusception diagnosed at necropsy involved calves less than one-year old, the majority being less than one-month old (1).

The proposed pathogenesis of intussusception involves hyperperistaltic activity in the proximal segment of bowel concurrent with relaxation of the distal segment (1,3). Postulated causes of the hyperperistalsis include parasitism, dietary changes, and viral or bacterial enteritis (1,3). In addition, the presence of mural lesions, intraluminal masses, foreign bodies, or simply the "knotting" of intestinal circular muscle have been incriminated as predisposing causes (1,3). Such a focal point is believed to serve as the apex of the intussusceptum which is then drawn by peristalsis of the longitudinal muscle into the distal, hypomotile, atonic segment. In this calf, no predisposing cause of the intussusception was identified.

The surgical technique employed was similar to that described to bypass obstructive lesions of the ascending colon secondary to the formation of adhesions (11), and during partial resection of the proximal ascending colon secondary to a cecal volvulus (12). This report further substantiates the value of this technique in the treatment of obstructive lesions in the proximal ascending colon of cattle. The use of mechanical stapling instrumentation reduced surgical time and allowed colonic resection and anastomosis with minimal contamination in a region of the bovine intestinal tract which is difficult to adequately exteriorize. cvj

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Abstracts

Effects of hexachlorobenzene feeding on surface epithelium of primate ovary

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Hexachlorobenzene (HCB), a toxic chemical that is released into the environment as a by-product of industries, accumulates in animal tissues, and has been implicated in female reproductive dysfunctions. We determined effects of HCB on surface epithelium of the ovary. Hexachlorobenzene mixed with glucose was given to eight cynomolgus monkeys in dosage of 0.0 or 0.1 mg/kg b.w. daily for 90 days. At necropsy, one ovary from each animal was removed, fixed in glutaraldehyde, and processed for transmission electron microscopy. Surface epithelium of control animals consisted of a single layer of squamous to cuboidal cells that contained cytoplasm rich in organelles, and possessed microvilli. After treatment, stratification of cells was observed in some areas. Many cells were tall columnar, highly irregular in outline, and showed signs of degeneration with nuclei migrating toward the apical surface; their cytoplasm contained many lysosomes, and numerous vesicles. Conclusion: **HCB is a toxicant with a potential to cause reproductive failure in primates.**

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Transplantation of naturally occurring bovine ocular squamous cell carcinoma to SCID and SCID-beige mice

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This study was initiated to develop a biologically appropriate model for the investigation of the role of the immune system in the initiation, progression and regression of BOSCC. Tumour tissue was transplanted into SCID (severe combined immunodeficient) and double mutant SCID-beige mice, which in addition to lacking functional B and T lymphocytes also have reduced NK cell activity. Grafts were placed intraperitoneally, beneath the renal capsule, and subcutaneously. Tumor growth was present in all engrafted mice within four weeks of transplantation. Bovine immunoglobulin was detected in the sera of some of the engrafted mice using bovine specific reagents in a standard immuno-electrophoresis assay system indicating cotransfer of intra-tumoral lymphocytes. These results suggest that tumor engrafted SCID and SCID-beige mice may be a useful model for the study of the immunopathology of BOSCC.

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