Bovine Gastrointestinal Surgery: Abomasal Volvulus Intestinal Surgery

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Introduction

Abdominal surgery in cattle has been performed by large animal practitioners for many years. Traditionally, the two most common major surgical procedures have been remenotomies and cesarean sections. During the past 10-15 years, however, the focus for gastrointestinal ailments has shifted from the rumen/reticulum to the abomasum and the intestinal tract. The most common abomasal disorder of surgical importance is displacement of the abomasum. There are a wide variety of other conditions involving the gastrointestinal tract, many of which are of surgical importance.

Bovine abdominal surgery is more popular and is more feasible for the average large animal practitioner than equine abdominal surgery. There are many reasons for this difference. Because of the docile nature of most dairy cows, general anesthesia is rarely needed, thus alleviating a major burden on personnel, facilities and equipment. Many abdominal conditions are common, thereby allowing the surgeon to become familiar with necessary surgical techniques. In addition, most cows do not require intensive medical therapy before and after surgery. These advantages, combined with the good prognosis often attainable, make for attractive relations between the veterinarian and client.

There is an oft quoted premise that cattle are more resistant to surgical infection than horses. It is my firm belief based on observation of abdominal surgery in both species, that this statement has no merit. In fact, the belief of this concept may be dangerous, because it may give the erroneous impression that one can achieve consistently favorable results regardless of the quality of surgical technique used. Two statements need to be remembered. First, the *healthy* peritoneum, regardless of species, is very forgiving. Second, surgical infections in cattle whether in the form of peritonitis or body wall infections, can be serious and fatal.

Terminology and Definitions

Auscultation—the process of listening to the sounds made by the various body structures (e.g. stomach compartments, intestines) as a means of diagnosis.

Percussion—a diagnostic procedure in which the surface (i.e. body wall) is tapped with the finger or plexor to determine the density of a part.

Auscultatory Percussion—simultaneous auscultation and percussion.

Ballottement—a diagnostic procedure that consists of rapidly pushing in on the flank with the clenched fist or finger tips. A hard structure, such as a fetus or impacted organ, may be felt either during the pushing motion or as the organ rebounds.

Succussion—a diagnostic procedure that consists in shaking the body in order to elicit a splashing sound in a cavity or cavities containing both gas and fluid. In large animals, the flank is repeatedly pushed in by the clenched fist of the examiner and then the flank is allowed to rebound.

Tympanitic Resonance ('ping')—a drumlike resonance obtained during percussion (more commonly, auscultatory percussion) over a large space filled with air. Three criteria must be fulfilled in order for a tympanitic resonant sound to be produced:

1. The viscus or cavity must contain air under pressure: the greater the pressure, the higher pitched the sound.
2. The viscus containing air must be positioned adjacent to the body wall. For example, a gas-filled cecum will not yield a ping if it is positioned in the center of the abdominal cavity instead of adjacent to the parietal peritoneum.
3. The body wall being percussed must be relatively thin, thereby allowing the energy from the fingertip to reach the gas-filled viscus and return as a resonant sound.

Celiotomy—surgical incision through the abdominal wall into the peritoneal cavity.

Laparotomy—surgical incision through the flank; has been used as a synonym for celiotomy.

Bovine Stomach—consists of 4 compartments: rumen, reticulum, omasum and abomasum. There is one stomach per animal; the use of the plural, bovine stomachs, is inaccurate.

Forestomach Compartments—a general term used to denote the compartments of the ruminant stomach proximal to the abomasum; namely, rumen, reticulum and omasum.

Choices for Celiotomy in Adult Cattle

The site chosen for entry into the abdominal cavity of

adult cattle is very important. Because of the large size of the abdominal cavity and its viscera and the snug attachments of viscera by mesentery and omenta, it is generally necessary to enter the abdomen close to the target organ. This underlines the importance of a careful diagnostic workup.

The following abdominal approaches are used routinely in adult cattle. The frequency of their use in general practice is indicated by:

* seldom used,
** frequently used.

**1. *Left Paralumbar Fossa Celiotomy*
Indications – *access to rumen, reticulum; rumenotomy*
– *access to uterus; hysterotomy*
– *correction of left displacement of abomasum (abomasopexy)*

**2. *Right Paralumbar Fossa Celiotomy*
Indications – access to small and large intestines
– correction of left displacement of abomasum (omentopexy)
– correction of right displacement of abomasum, abomasal volvulus
– access to uterus; hysterotomy
– access to left or right kidney

**3. *Right Paramedian Celiotomy* (Cranial to umbilicus)
Indications – correction of left or right displacement of abomasum, abomasal volvulus (abomasopexy)

*4. *Right Paracostal Celiotomy*
Indications – access to pyloric part of abomasum, pylorus and cranial part of the duodenum
Technique – either a) vertical incision ventral to the 10th or 11th rib, extending to the superficial epigastric (mammary) vein; or b) incision parallel to the costal arch from transverse planes of 8th to 13th ribs.

**5. *Midline Celiotomy* (caudal to umbilicus)
Indications – access to uterus; hysterotomy

*6. *Ventrolateral Celiotomy* (lateral and cranial to mammary gland)
Indications – access to uterus; hysterotomy, especially if fetus is emphysematous
– suturing of uterine tear if postparturient uterine laceration
Caution – body wall closure may be difficult

Right Side Displacement of the Abomasum; Abomasal and Omasal Volvulus

Right side displacement of the abomasum (RDA) is physiologically similar to LDA. The abomasum becomes distended with gas and rises adjacent to the adominal wall. There are several theories as to the most common forms of abomasal migration:

1. If gas accumulates first in the fundus, the abomasum will rotate counterclockwise as viewed from the right side of the cow. The fundus will move dorsally, then caudally so that it is positioned deep to the 9-12th ribs.
2. If gas accumulates first in the pyloric part, the abomasum will rotate clockwise as viewed from the right side. The pylorus will move dorsally, then cranially, then cranioventrally and will be positioned deep to the 9-10th ribs.
3. If gas accumulates first in the body, the abomasum may rotate in a counterclockwise direction as viewed from behind the cow. The greater curvature will move to the right and dorsally and will rest beneath the 9-13th ribs.

Regardless of the method of rotation, complete gastrointestinal obstruction does not occur. As in cattle with LDA, the course of illness may be chronic. The area of ping is outlined in the appendix. Note the absence of fluid in the abomasum, thus the circular field of resonance. In cattle with long standing RDA, fluid may be present; this could result in confusion in the differentiation between RDA and volvulus.

Surgical correction is by right paramedian abomasopexy or right paralumbar fossa omentopexy as described under LDA. A left paralumbar fossa abomasopexy is obviously inappropriate because the abomasum is positioned on the right side of the rumen. Percutaneous abomasopexy is strongly discouraged because abomasal volvulus rather than simple RDA may be present.

What about *Rolling* a cow with RDA?

> This is inappropriate. The whole idea of rolling a cow is to move the distended abomasum from the left side to the right side. In a cow with LDA, this in effect, produces a temporary RDA. If the cow is laid on its right side, the abomasum would be compressed by the rumen. In addition, rolling a cow with an RDA may produce a volvulus.

Volvulus of the abomasum is often accompanied by volvulus of the omasum. The use of the term "torsion" is discouraged, although there is much controversy. In my opinion, torsion should be used when referring to a twist along the long axis of a part. For example, volvulus of the abomasum and omasum is accompanied by torsion of the esophageal groove and of portions of the omentum.

Volvulus may occur secondary to RDA or may occur acutely in a cow without previous evidence of RDA. The condition is most common in adult dairy cows during early stages of lactation, although it is often seen in pregnant cows, bulls, and in calves.

The mechanics of volvulus are complicated, confusing and poorly understood. Suffice it to say that the abomasum, often accompanied by the omasum, undergoes a rotation or volvulus resulting in:

1. An obstruction of the cranial part of the duodenum, and;
2. An obstruction of the reticulo-omasal or omasoabomasal orifices. The liver is pushed and folded medially by its attachment to the fundus of the abomasum.

The following clinical signs are representative of a cow with abomasal and omasal volvulus:

1. Acutely ill with rapid deterioration—may have LDA/RDA for days or weeks before volvulus; usually die in 72-96 hrs if untreated.
2. Elevated pulse rate (80-140/min).
3. Rapid dehydration.
4. Anorexia.
5. Feces scant and loose; sometimes absent, with mucus in rectum.
6. Area of tympanitic reasonance over right abdominal wall from ribs 8 or 9 to mid part of the paralumbar fossa.
7. Abomasum palpable per rectum.
8. Splashing sounds of abomasal fluid heard on succussion of the right flank.

These clinical findings are representative of a cow with prolonged (24-72 hours) volvulus. Cows with early volvulus are difficult to distinguish from those with RDA.

The duodenum becomes occluded before the reticulo-omasal or omasoabomasal junctions. Because of the duodenal obstruction, abomasal contents do not pass into the small intestine. The abomasum, already gas-filled, continues to secrete fluid rich in HCl. Some of this fluid is refluxed into the rumen, a process referred to as "internal vomition". Later, when the twist is severe enough to cause obstruction proximal to the omasum or abomasum, the abomasum expands more rapidly. With this sequestration of HCl and water in the abomasum and forestomach compartments, the cow becomes dehydrated and develops hypochloremic, hypokalemic metabolic alkalosis.

Cows with early volvulus may be operated on in dorsal recumbency through a right paramedian incision. In these cases, removal of fluid is not necessary to facilitate reduction of volvulus. The abomasum is deflated, untwisted and anchored in its normal position by abomasopexy.

If a large amount of fluid is present in the abomasum, it should be removed before reduction of the volvulus. This is usually best accomplished with the cow standing, using the right paralumbar fossa approach. Upon entry into the abdominal cavity, the greater curvature of the abomasum is visible at the level of the cranial portion of paralumbar fossa. A purse string suture is placed through the seromuscular layers of the abomasum and a ½" internal diameter sterile stomach tube is inserted within the limits of the suture. The fluid can be siphoned from the abomasum in this manner and the abomasotomy closed.

Reduction of the volvulus is accomplished in the following manner. Put your left hand and arm along the left side of the abomasum so that your hand rests at the pylorus. Using your entire forearm and hand, push cranioventrally and laterally (toward the right). The aim is to free the entrapped duodenum from its position in the cleft between the reticulum and omasum (or between the omasum and abomasum). Keep pushing in this manner until the pylorus and cranial duodenum can be pulled caudally and then dorsally to the incision. What you have done is to rotate the abomasum in a clockwise direction as looking from the right side of the cow. *Regardless of the direction of original volvulus,* this pattern of surgical manipulation should reduce the volvulus in almost all cattle.

Following reduction, check the positioning of the omasum and abomasum anchor the pylorus by omentopexy.

Fluid Therapy—Intravenous therapy is necessary only in the severly affected cows in which dehydration is prominent and in which there is a large amount of abomasal fluid to be removed. Isotonic (0.9%) NaCl with 20-40 mEg/l KCl added is recommended. In a 600 kg cow that is 10% dehydrated, the calculated fluid deficit is: 10% of 600 kg = 60 l. In general 20-30 l of fluid IV would be sufficient for this cow. Following surgery, hydration could be supplemented by oral fluids given free choice or by stomach tube.

Formula for oral replacements fluid (treatment of metabolic alkalosis):

1 oz (30 gm) KCl powder
2 oz (60 gm) NaCl powder
q.s. 5 gallons water

Allow free choice fresh water and salt block.

Prognosis—if corrected during early stages of volvulus, affected cattle have a very good prognosis. In later stages, by the time that a large amount of fluid has accumulated in the abomasum, the prognosis is much poorer. This is due to direct damage to the ventral branch of the vagus nerve as it courses between the reticulum and omasum. If the nerve is damaged by compression, a form of postoperative vagal indigestion is common. The forestomach compartments and abomasum become distended with digesta; gastric emptying is reduced. The long term prognosis in these cows is poor.

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Surgical Anatomy of the Bovine Intestinal Tract

A clear understanding of the intestinal anatomy as viewed through the right paralumbar fossa is the single most important factor in determining the degree of success to be achieved in the surgical management of intestinal disorders in cattle. Because of the abundant mesenteric fat, and the difficulty in exteriorization of the intestines due to the shortness of the mesentery, surgical manipulation of the bowel is often difficult.

I. Viscera

In the nonpregnant cow, the *Pylorus* is located at the level of the 9th or 10th costochondral junction.

The *Duodenum* has three parts. The *Cranial Part* extends dorsocranially from the pylorus; proximally, it is mobile but distally it is tightly adherent to the visceral surface of the liver. It forms an S-shaped curve in the region of its attachment to the liver. The common bile duct enters the duodenum at this point. The *Descending Part,* suspended dorsally by its mesoduodenum, continues caudally along the right side of the dorsal portion of the abdomen. The superficial and deep walls of the greater omentum attach to the ventral surface of the descending duodenum. The *Ascending Part* passes cranially, to the left side of the mesenteric root. It is closely attached to the descending colon by the duodenocolic ligament.

The *Jejunum* is very long and forms a multitude of tight coils around the edge of the mesentery. It normally lies completely within the supraomental recess. The mesentery of the distal jejunum and proximal ileum is longer than the mesentery of the remainder of the jejunum. This distal segment of jejunoileum forms a long, mobile, "flange" which extends caudally within the supraomental recess.

The *Ileum,* the terminal part of the small intestine, consists of a convoluted proximal part and a straight distal part. It is attached to the ventral border of the cecum by the ileocecal fold and enters the cecocolic junction obliquely on its ventral surface. In the adult, the ileocecocolic junction is obscured from view by a thick layer of mesenteric fat.

The *Cecum* is a large, mobile sac, the apex of which is directed caudally. Cranially, the cecum is continuous with the colon and there is no valve or stricture between these two segments of the large intestine. Thus the anatomic division between the cecum and colon is the point at which the ileum enters. The cecum is usually located within the supraomental recess but it may be found outside, positioned between the greater omentum and the right abdominal wall.

The *Ascending Colon* is comprised of three parts. The *Proximal Loop of the Ascending Colon* (Proximal Colon) continues cranially from the cecum then folds back just dorsal to the first portion and proceeds caudally. It then turns forward and proceeds cranially on the left side of the mesentery. The *Spiral Loop of the Ascending Colon* (Spiral Colon) is a continuation of the proximal loop, thus is located on the left side of the mesentery. There are 1½ - 2 centripetal coils followed by the same number of centrifugal coils. The outside loop is the portion which lies closest to the ileum as it proceeds in a counter-clockwise direction as viewed from the cow's right side. The *Distal Loop of the Ascending Colon* (Distal Colon) proceeds dorsally and caudally on the left side of the mesentery from the distal centrifugal coil of spiral colon. It then passes from the left to the right side of the mesentery and travels cranially adjacent to the proximal colon. It ends at the *Transverse Colon* which is the short segment of bowel that passes from right to left around the cranial surface of the cranial mesenteric artery.

II. Mesentery

Much of the difficulty in exploring the bovine intestine is due to the short, fat-laden mesentery. Attached to its left surface is the spiral colon and portion of the proximal and distal colon. The jejunoileum is coiled around the free edge of the mesentery.

The dorsal parts of the intestines, namely, the descending and ascending parts of the duodenum, the proximal and distal colon, and the proximal segment of the descending colon are tightly apposed because their mesenteries are mostly fused.

III. Greater and Lesser Omenta

The *Greater Omentum* is voluminous. The *Superficial Wall* attaches along the left longitudinal groove of the rumen and extends ventrally and to the right, encircling the intestinal mass. It then rises dorsally and attaches to the descending duodenum caudally and the cranial duodenum, pylorus and greater curvature of abomasum cranially. The *Deep Wall* attaches to the right longitudinal groove of the rumen and also extends ventrally and to the right beneath the intestines. It joins the superficial wall in its attachments to the abomasum and duodenum. At their caudal borders the two walls are fused, thus the greater omentum can be grasped here and drawn forward in order to expose the intestinal viscera.

The *Lesser Omentum* extends from the esophagus, along the reticular groove and base of omasum and attaches to the lesser curvature of the abomasum. It mostly covers the parietal (right) surface of the omasum.

Exposure of Intestines in Adult Cattle Through A Right Paralumbar Fossa Celiotomy

	Exposure		
	For Exteriorization	For Palpation	Relative Surgical Importance
Pylorus	good	good	very important
Duodenum:			
Cranial Part	fair	good	very important
Descending Part	good	good	moderately important
Ascending Part	good	poor	minimally important
Jejunum:			
Proximal Third	poor	fair	moderately important
Middle Third	fair	good	moderately important
Distal Third	good	good	very important
Ileum good	good	very important	
Cecum good	good	very important	
Ascending Colon			
Proximal Loop	good	good	very important
Spiral Loop	fair	fair	moderately important
Distal Loop	poor	poor	minimally important
Transverse Colon	poor	poor	minimally important
Descending Colin	fair	good	moderately important
Rectum	poor	good	minimally important

Surgical Conditions of the Bovine Intestinal Tract

I. Intussusception

Clinical Presentation:

Intussusceptions in adult cattle occur most frequently in the distal jejunum and ileum; whereas, in calves, they occur throughout the small and large intestines, including the ileocecocolic junction.

Cattle display signs of colic initially, but this gradually subsides in 6-18 hours and the animal becomes progressively depressed. If untreated, most cattle will survive for several days before local, then generalized, peritonitis develops. There are scattered reports of cattle in which the intussusception sloughed spontaneously and passed into the lower tract.

Feces are scant and loose initially, then often contain dark red, mucoid material. There is reflux of intestinal and abomasal fluid into the forestomach compartments; this causes bilateral abdominal distention. Distended small intestine (proximal to the lesion) is usually palpable per rectum and often the intussusception itself can be felt in the upper right portion of the abdomen. Several small areas of tympanitic resonance (ping) are sometimes heard during auscultatory percussion of the right paralumbar fossa.

Cattle become severely dehydrated and develop profound hypochloremic metabolic alkalosis due to abomasal reflux.

Surgical Correction:

The abdomen is explored through the right paralumbar fossa with the cow either standing or in left lateral recumbency. If the rumen is greatly distended, exploration of the abdomen from the right side is difficult. In this case, try to drain some of the rumen contents using a large bore stomach (Kingman) tube.

The small intestine proximal to the lesion is fluid-and gas-filled; distal bowel is flaccid. Isolate the lesion and exteriorize it as much as possible. Resect the involved segment and perform an end-to-end anastomosis. I prefer a single layer apposing technique using absorbably or monofilament non-absorbably suture material. Be sure to repair the mesenteric defect. Rinse the anastomotic site and close the abdomen routinely.

Prognosis is good, especially if surgery has not been delayed.

Potential Surgical Complications:

If surgery is performed with the cow standing, it often will become exhausted or intractable partway through the procedure and lay down. This is frustrating and potentially dangerous. It is better to start with the cow in lateral recumbency if you feel this is likely to happen.

Failure to carefully close the mesenteric defect may result in internal hernia formation. Wide excision of mesentery may interfere with the vascular supply to remaining bowel. Stay as close to the bowel as possible when cutting the mesentery.

II. Incarceration

This is uncommon in cattle. When it occurs, it is usually due to entrapment of a segment of the distal jejunoileum ("flange") in a mesenteric or omental rent (internal hernia) or around a fibrous band or stalk, such as round ligament of the liver, vitelloumbilical band or Meckel's diverticulum.

Clinical presentation is similar to that observed with intussusception. Treatment is by reduction of the incarceration and resection and anastomosis if necessary. Where applicable, the offending band or stalk should be transected or excised.

III. Small Intestinal Volvulus: Volvulus of the Intestinal Mass About the Mesenteric Root

Clinical Presentation:

There are two clinical entities. In small intestinal volvulus, there is a twist of a segment of distal jejunoileum about its mesentery. Sometimes this portion of bowel twists around the cecum and/or proximal colon. The involved intestine distends with gas and fluid; in severe cases, frank blood accumulates in the lumen. If the vascular supply is occluded, strangulation and ischemic necrosis result.

Clinical signs vary with the amount of bowel involved and with the severity (degree) of twist. In most cases, the cow exhibits signs of severe colic initially, then becomes depressed and rapidly deteriorates.

In cattle with massive intestinal volvulus, the majority of the small and large intestines twist about the mesenteric root, thus causing occlusion of the cranial mesenteric vessels. The cause is mechanical, for example, rolling the cow for surgery. In some cases, however, the condition also occurs spontaneously. Very severe colic results acutely, the intestines rapidly distend, and the cow dies in 4-8 hours.

Surgical Correction:

The abdomen is explored through the right paralumbar fossa with the cow standing or in left lateral recumbency.

If only a portion of the jejunum is involved and the bowel is not ischemic, untwist but do not resect the bowel. If ischemia is present, resection is necessary. Removal of more than 5-10 meters of small intestine may seriously limit absorption of nutrients in a production animal.

Surgical correction of mesenteric root torsion usually causes immediate death of the cow, probably due to rapid release of tissue metabolites into the blood stream. Prognosis with this condition is grave.

IV. Cecal Dilatation: Cecal Volvulus

Clinical Presentation:

The etiology of these diseases is obscure although it may be related to increased volatile fatty acid production in a similar manner to abomasal displacement. Volvulus is probably secondary to dilatation of the cecum and usually causes obstruction of the ileum proximally and of the colon distally.

Signs of volvulus are those of acute obstruction with failure to pass feces (mucus may be present). Colic is present

early in the condition. A ping is heard over the right paralumbar fossa and may extend cranially to ribs 11-13. Rectally, either the body of the cecum or the proximal colon is palpable and distended with the cecal apex being directed cranially. Distended jejunum and ileum are also present. This is in contrast to simple cecal dilatation without volvulus, in which digesta is able to pass from the ileum to the colon. The cecal apex is directed caudally and there is minimal small intestinal distention.

Surgical Correction:

Enter the abdomen through a right paralumbar fossa celiotomy. Exteriorize the cecum and proximal colon: remove as much digesta as possible through a stab incision in the apex of the cecum. Replace the organ into the abdomen and correct the volvulus.

The cow should pass feces within 4-6 hours of surgery. Prognosis is good. Simple dilatation of the cecum usually does not necessitate surgery but these cows should be monitored closely for signs of deterioration.

In cases of prolonged volvulus, the cecum may be necrotic and have to be resected. This is difficult and involves removal of the cecum including the ileocecocolic junction. The ileum is then anastomosed to the proximal loop of the ascending colon in an end-to-side manner.

V. Obstruction of the Spiral Colon by Extraluminal Constriction

This is a recently recognized condition and is related to the obstruction of the spiral colon by adhesions due to previous surgery, by fat necrosis in the mesentery, or by adhesions caused by intraperitoneal injections of irritating drugs through the right paralumbar fossa.

Sings are those of gradual obstruction occurring over a period of days or weeks. A firm mass can often be palpated in the right paralumbar fossa and the adhesions can usually be felt per rectum. Repair, if possible, is through the right paralumbar fossa. The obstruction is bypassed by means of a side-to-side anastomosis between the bowel proximal and the bowel distal to the obstruction. The involved bowel is left in situ and none is removed. Prognosis is fair.

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