

# Rumenotomy: Approaches and practical aspects

Michael Maroney, DVM, ABVP-Dairy  
Senior Program Veterinarian Emeritus  
University of Wisconsin- Madison Research Animal Resource Center  
Madison, WI 53726

## Abstract

There are many veterinary related indications for accessing the rumen. However, opening the rumen can be a daunting task, especially under field conditions. This article reviews approaches to rumenotomy and rumenostomy, with a detailed description of the refinement of a two-stage surgical rumen cannulation procedure.

**Key words:** rumenotomy, rumenostomy, cannulation, fistulation

## Definitions

Rumenotomy refers to the surgical opening of the rumen during a surgical event. While rumenostomy refers to creating a temporary or permanent opening or “stoma” into the rumen. The term fistulation refers to the surgical creation of a fistula, which in this case is an opening between the rumen and skin lined with granulation tissue. A rumen cannula is a rubber or plastic medical device placed in the rumen fistula with the goal of keeping the rumen contents in place while allowing access to the rumen.

## Indications

There are many veterinary related reasons for surgically accessing the rumen. Some reasons are urgent, and others address chronic or elective concerns. In the clinical realm, rumenotomies are performed on animals with acute grain overload. If early in the clinical event, rumenotomy may be used as a means of removing the grain, in conjunction with medical treatment (mineral oil, C+D antitoxin, penicillin, flunixin meglumine). Foreign objects occasionally find their way into the rumen either by administration of oral medicine or by ingestion. Traumatic reticuloperitonitis is caused when sharp metal objects penetrate the reticulum. Impaction of the reticulo-omasal orifice can be caused by sand or plastic. Choke can occur when a foreign body or feed is caught in the distal esophagus. The use of a trocar in the case of bloat when the patient is in severe respiratory distress is a form of rumenotomy. In cases of chronic bloat, a rumenostomy is indicated to create a pressure valve to ensure that the animal does not succumb to acute bloat. Research farms utilize cattle that have had a rumenostomy to create a rumen fistula and place a cannula, so they have direct access of the rumen. Private farms or veterinary clinics may have a rumen cannulated animal to serve as a rumen fluid donor.

## Rumenotomy

### Trocar placement

In an emergency a plastic or metal trocar can be placed to relieve gas trapped in the rumen. The placement should be about five inches (12.5 cm) below the transverse processes of the lumbar vertebra (short ribs) centered in the paralumbar fossa. With bloat, the rumen wall is compressed against the abdominal wall. If time allows, a local anesthetic should be used. A scalpel is used to make an incision in the skin the diameter of the trocar. The trocar with cannula is thrust through the skin and into the

rumen. The plastic trocars have a screw design to allow you to thread the trocar through the tissue layers. The last thread helps secure the rumen to the body wall. If foam pours out, surfactant medication must be instilled into the cannula (rumen). The metal cannulas are secured to the skin with suture. The temporary cannulas are removed after 2 weeks when a fistula is formed.

### Surgical approaches

Methods of securing the rumen to the skin are the source of variation in different procedures. Dehghani and Ghadrani<sup>1</sup> compared 4 surgical techniques that differed in the manner of securing the rumen to the incision. The 4 techniques were: rumen skin suturing fixation (RSSF), Weingarth’s ring rumenotomy (WRR), stay suture rumenotomy (SSR) and rumen skin clamp fixation (RSCF). The animals were held of food for 24 hours and water for 12 hours. In the RSSF approach, after routine laparotomy, the rumen serosal surface is sutured to the skin with an inverting Connell suture pattern. Once the rumen was secured to the skin an incision into the rumen was made and exploration of the rumen occurred prior to closure. For the WRR approach, a Weingarth’s (also spelled Weingartz) frame is secured to the incision with thumb screws. The rumen is exteriorized and incised, and the edges are secured to adjustable clamps attached to the frame. The SSR approach simply used four stay sutures anchoring the rumen at 12, 3, 6 and 9 o’clock position. In the RSCF method Backhaus towel clamps are used to secure the rumen to the skin in 6 to 8 locations. Initially they secured the dorsal and ventral commissures and then secured the edges as they made their incision into the rumen. Researchers followed body temperature, WBC counts and neutrophil to leucocyte ratio, as well as postmortem examination. While the RSSF technique took about 20 minutes longer, it was significantly better than WRR and SSR in regards to body temperature and WBC counts. The RSSF and RSCF performed similarly. Not surprisingly, at necropsy the SSR group had extensive adhesions in 3/5 animals in the group.

The location of the incision within the left paralumbar fossa is influenced by purpose of the surgery. If you need to examine the reticulum for suspected hardware disease, make the incision as close to the last rib as possible. For foreign body retrieval, a more centralized location is suitable. Once the location is selected, then the length of the incision is determined by the girth of the surgeon’s arm. Rumenotomy is performed through a left flank incision as described for laparotomy.<sup>2</sup> An abdominal cavity exploration is indicated and sites with adhesion are noted but not disturbed. The challenge with a rumenotomy is how to prevent contamination of the abdominal cavity and incision with rumen contents. Holding the animal off feed for 24 hours will reduce the size of the rumen fill and aid in this effort. Suturing the serosal surface of the rumen to the edge of the skin incision is the conservative approach. To assist this task the rumen is grasped with gauze and slightly exteriorized in order to place 2-4 temporary stay sutures. This will appose the tissues so an inverting continuous pattern (e.g. Cushing, Connell) can be placed. Suture lines are anchored at 1 and 7 o’clock positions.

Individual sutures may be placed to oversee the ventral aspect. Once the rumen to skin junction is secured the rumen is incised and exploration of the rumen can be carried out. After the exam, the rumen wall is closed with a row of continuous inverting sutures of no. 2 or 3 absorbable suture (e.g. catgut or PDS). A second inverting suture line can be placed to over sew the incision line based on surgeons' preference and vitality of tissue. When a second suture line is placed the rumenotomy suture line is included in the enveloped tissue. The site is then irrigated with polyionic solution, and the rumen fixation sutures or apparatus are removed. After cleaning the rumen incision, the surgeon should replace the drapes, gloves and use sterile instruments to close the laparotomy incision in a routine 3-layer closure.<sup>3</sup>

## Rumenostomy (rumen cannulation)

### Surgical rumen cannulation

Lafin and Gnad<sup>4</sup> provide a detailed description of a one-step technique with a circular incision. Briefly, a template is used to make a circular incision. They emphasize the important point of using the template to trace the outline prior to full thickness incision. Once the skin plug is cut out the tension of the skin will enlarge the circle. They encourage gridding, which is using your finger or forceps to separate the muscle parallel to the muscle fibers. These intact muscle bundles help anchor the cannula in place. After entry to the abdominal cavity, gauze is used to exteriorize the rumen and secure it to the skin with horizontal mattress sutures at the dorsal, ventral, cranial and caudal aspects of the incision (12, 3, 6 and 9 o'clock). The rumen is then entered and the margin sewn to the skin. After completely suturing the rumen to the skin, the cannula is placed. Ten days post-surgery the cannula is removed and the sutures along with a necrotic ring of tissue are removed. Broad spectrum antibiotics are given for 7 days post-surgery. Noordsy<sup>5</sup> describes a similar one step cannulation procedure, but the incision is elliptical, and the sutures are interrupted horizontal mattress.

Turner and McIlwraith<sup>2</sup> describe creating a small fistula in the case of chronic rumen bloat. The techniques are similar, a 1 ½-inch (4 cm) circular incision is made in the paralumbar fossa. The muscles are bluntly dissected, and the external abdominal oblique may be partially removed to help with rumen exteriorization. The rumen serosa is sutured to the skin with a simple interrupted pattern using nonabsorbable suture. The goal of this approach is to create a pop-off valve like function where the abdominal muscles help to keep rumen contents in, but if pressure builds gas can escape.

### Two-staged rumen cannulation (clamp method)

When the fixation of the rumen and the placement of the cannula occur in separate procedures, days apart, the term "two-stage" has been used to describe the procedure. Martineau, et al.<sup>6</sup> has described a surgical procedure where the rumen is exteriorized during the initial surgery and secured in a wooden clamp, which is the sutured to the flank. This procedure utilized a linear incision and relied on a scarified rumen serosa to adhere to the body wall before release of the clamp. These procedures occurred at 2 different research facilities and the authors reported their adverse outcomes. One hundred and seventy-two animals participated in the study. Two animals died from peritonitis; 2 animals aborted within 10 days of the surgery and 3 animals had the rumen slip out of the clamp but apparently adhesions had formed to prevent overwhelming peritonitis. Their complication rate was 7/172 (4%). Newby, et al.<sup>7</sup> used this

research model to investigate the effects of ketoprofen following fistulation. The results demonstrated that the procedure was painful and that ketoprofen treatment relieved some but not all of the associated pain. Schramm, et al.<sup>8</sup> compared the physiological and welfare parameters between the one-step surgical and two-stage clamp procedure on sheep. The physiological responses were similar, but dry matter intake was depressed in the two-staged group. The authors recommend the one-step procedure to improve post operative welfare.

### Two-staged surgical rumen cannulation

This approach was first described by Jarrett in 1948.<sup>9</sup> The author and colleagues refined this approach to reproducibly create rumen fistulated cattle with good fitting and minimal complications. All procedures were covered by the University of Wisconsin Institutional Animal Care and Use Committee (protocol No. A005480-R01). Unlike rumenotomy, where the animals are held off feed, we prefer the rumen is mostly full, but not tight. To do this we have the animal caretakers feed 75% of their ration; any residual feed is removed first thing the morning of surgery. The reason is that we want the rumen to lay in its natural position adjacent to the body wall. While we have done these surgeries at different ages and stages of lactation, we primarily perform them on recently dry cows. Diet and housing changes are made at least one week prior to surgery so animals have time to acclimate. In immature animals, the diameter of the fistula will grow with the animal. The result of this dynamic is a cannula-fistula mismatch leading to ruminal fluid leakage. Rumen fluid donors should be healthy mature cows, with good feet and legs and a large enough paralumbar fossa to accommodate the cannula.

The animals are restrained in a chute and a physical exam is performed. Animals are routinely sedated with either xylazine 0.005 mg/lb. (0.012 mg/kg) and butorphanol 0.005 mg/lb. (0.012 mg/kg) or xylazine 0.005 mg/lb. (0.012 mg/kg), butorphanol 0.003 mg/lb. (0.006 mg/kg) and ketamine 0.02 mg/lb. (0.05 mg/kg) administered intravenously (IV). In practice, an adult 1,700 lb Holstein cow would receive a mixture of 10 mg xylazine, 10 mg butorphanol or 10 mg xylazine, 5 mg butorphanol, and 40 mg ketamine. For post operative pain relief, patients receive flunixin meglumine 0.5-1.0 mg/lb. (1.1-2.2 mg/kg) intravenously SID just prior to surgery and repeated in 24 hours. Animals are also treated with ampicillin once daily for 5 days. The dose is: ampicillin 5 mg/lb. (11 mg/kg) and route of administration is IM. Hair is clipped from the dorsal midline to the fold in the flank and cranially to 12th rib and caudally to tuber coxae. The site is aseptically prepared by alternating scrubs with gauze soaked in 1% iodine scrub and alcohol 3 times. Local anesthetics are administered after the second scrub. Lidocaine 2% is used for flank anesthesia, either with a distal paravertebral (10-20 ml each site) or inverted L block (1.35 mg/lb.). We use disposable paper drapes and secure them to the animal with a line of tag cement on the short ribs of the opposite side.

To position the incision in the fossa, we use a circular template of disposable surgical drape, cut to the diameter of the cannula (9.5 inches or 25 cm) with a small hole in the center. Position the template so it minimizes contact with the last rib and lumbar transverse processes. Once positioned, the center is marked with a scalpel. Then a 4-inch (10 cm) template with a hole in the center is used to trace the incision with the scalpel. The skin plug is cut out and dissected from the subcutaneous tissue. The subcutaneous tissue and external abdominal oblique are excised from upper left to lower right. The internal abdominal

oblique is bluntly gridded from upper right to lower left. The muscle incisions form an “X” and are important for holding the cannula in place. The peritoneum is grasped with a rat tooth forceps and pulled through the incision for incising; the opening is extended with a scissors in a pattern like a peace sign. The rumen is grasped with gauze and exteriorized. Horizontal mattress stay sutures are placed at 12, 3, 6 and 9 o'clock position with #3 polymerized caprolactam suture. The stay suture placement is very important for final incision shape. Try to superimpose the 4-inch circle on the rumen serosa. First place the dorsal (12 o'clock) and then ventral (6 o'clock) stay sutures and they should be 4 inches apart. Likewise, the cranial (9 o'clock) and caudal (3 o'clock) stay sutures should be 4 inches apart. Starting at 12 o'clock, the serosal surface of the rumen is sutured to the skin with a simple continuous pattern using #2 polydioxanone (PDS) suture. Stay sutures are removed as they are encountered. Suture bites should be no more than a half inch apart (1 cm) and oriented perpendicular to the arc of the incision. This allows for good blood flow to the margin of the incision. While the suture goes completely through the skin, the bite into the rumen should be in the muscularis and not the lumen. Knot placement is usually at the 12 and 6 o'clock position. Just prior to the tying the final knot, a metal fenestrated Poole suction cannula, attached by hose to a suction pump, is placed into the abdomen to evacuate air. Remove the instrument once the pump's motor starts working harder. Tension is kept on the suture to keep a tight seal. This step is important for reducing subcutaneous emphysema. Surgery is accomplished in 30-40 minutes.

The animals are housed in individual stalls until the rumen plug is excised and the 3-inch cannula inserted. Some animals may have to be tied with a halter to prevent them from licking the site. This is especially important for Jerseys. We have had cattle housed in pairs in small pens, but you must keep a watchful eye on them. We prefer not to do the surgery during the fly season but have done so in barns with fans and good fly control. A small rectangular drape is secured to the flank covering the surgical site with tag cement (a reverse seven-shaped line along last and short ribs). This allows topical application of fly spray (Catron®). Patients have their body temperature recorded daily for the first 5 days after surgery and the veterinary staff is notified if the temperature is above 103° F or if their appetite is depressed by 25%. Until temporary cannula placement the incision is cleaned daily with dilute 4% chlorhexidine gluconate-soaked gauze, rinsed with 0.9% saline, dried and triple antibiotic ointment applied. Usually, 4 days (range 4-6) after surgery the rumen plug is excised. The animals are sedated with xylazine: butorphanol as described above. While the excision of the rumen wall is not painful, sometimes the placement of the cannula can stretch the incision. After cleaning the surgical site, a scalpel is used to excise the rumen wall plug. Care is taken to stay about a quarter inch (0.6 cm) away from the suture line. Any significant bleeders are ligated with 2-0 absorbable suture. Then a temporary 3” rubber cannula<sup>a</sup> is inserted, until the fistula is healed and remodeled (3-4 weeks). Cannulas are soaked in hot water with chlorhexidine disinfectant. The hot water makes the cannula malleable to aid in insertion. To insert a cannula, you reach through the hole and grab the inner flange, pulling its edge through the hole. This distorts the inner flange to a point that can be placed in the fistula and the exteriorized inner flange is pushed back through the hole to complete the insertion into the rumen. Once the temporary cannula is placed, the site is cleaned as describe above 3 times a week until suture removal at 2 weeks post-op. At that time the cannula is removed, site is cleaned, and the suture knots are cut out. It is not

necessary to remove all the suture material because it works its way out once the knots are cut. There will be variable amounts of necrotic tissue that sloughs, revealing reorganized granulation tissue that lines the fistula. Necrotic tissue can be gently debrided while cleaning with gauze. Once healing is complete the 4” cannula<sup>b</sup> is placed. If the animal appears painful due to stretching of the fistula, we may give butorphanol or simply delay the insertion of the 4” cannula another week. We reuse the 3” cannulas for a total of 3 procedures before we throw them out. We have pushed back the final 4” cannula placement to close to 4 weeks. At that point the granulation tissue is reorganized, and we create less pressure necrosis with the cannula placement.

## Complications

Over the past 17 years we have performed this approach with cattle over 300 times. We rarely have a fever post-op and, in those cases, we would treat with a broad-spectrum antibiotic. We had 3 cases of peri-incisional abscesses. Two of those were managed by drainage and the third was euthanized because of concerns over the affects the abscess would have on rumen contractions and function. We commonly have some degree of subcutaneous emphysema. The suction pump has greatly improved this complication and emphysema typically resolves in about 7-10 days. Delaying the cannula insertion until the fistula is completely healed has improved our cannula-to-fistula fit. Long term cleaning around the cannula is not performed routinely. We find that when there is a gap between the fistula and cannula, feed will get impacted, stopping the rumen fluid from draining down the side of the animal. Research and animal care staff monitor the cannula for sores and if present, trim the cannula and apply topical antibiotic ointment.

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## Endnotes

- <sup>a</sup> #4C 3” rumen cannula, Bar Diamond, inc., Pharma, ID
- <sup>b</sup> #1C 4” rumen cannula, Bar Diamond, inc., Pharma, ID

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