

Title: Rumen Cannulation

Species: Ruminant

Last Updated: 3/2/2006

Purpose

Rumen cannulation allows long-term, minimally invasive access to the rumen cavity. Rumenally cannulated animals are used for in vitro digestion studies, as a source of rumen contents for in vivo studies, and for access to other digestive tract compartments. The use of cannulas allows one animal to be used for multiple simultaneous digestion assessments, thereby reducing the number of animals required for experimental procedures. Once cannulated, animals may be maintained for years and reused on many studies with no detectable differences from non-cannulated animals. Properly maintained cannulated animals eat, gain weight, and reproduce the same as any non-cannulated animal.

Potential Impact on Animals

Short-term, the surgical procedure itself causes minor to moderate discomfort for the first 1-7 days post-operatively. Appropriate use of analgesics returns rumen function and animal behavior to normal shortly after recovery from anesthesia. Minor leakage may occur during the immediate post-surgical period while a good seal is developing around the cannula.

Long-term, the rumenotomy hole in which the cannula resides may expand and allow the cannula to leak rumen contents, particularly when animals are maintained on highly fermentable diets. Leaking rumen fluids themselves are not harmful to the skin, but constant moisture on the side of the animal can lead to skin irritation. Additionally, leakage of rumen contents attracts flies. Leakage can be greatly reduced by proper surgical technique and selection of appropriately sized cannulas, but some leakage may occur throughout the life of the animals. Cannulas may need to be replaced with larger models or gaskets used as the animal grows and the rumenotomy site expands. Poorly sealed cannula plugs or lost plugs for prolonged periods of time may result in dehydration and altered rumen flora.

Procedure Description

CANNULA SELECTION

The size of cannula used must be appropriate for the size of animal and the research needs. It is best to start adult bovines with a 3 inch diameter cannula, switching to a 4 inch as needed a few weeks to months following surgery as the rumenotomy wound expands to its final shape. If leakage is a problem once the 4 inch cannula is used, washers may be used on the rumen side of the cannula to prevent leakage.

RECORDS MAINTENANCE

Complete medical records including temperature, pulse, respiration, feed intake, attitude, evaluation of the surgical site, milk production, anesthetic and surgery logs, and date, time, and amount of drugs administered are maintained until the animal is returned to the herd. All FDA required drug withdrawal times for milk and meat are followed. All records are maintained for at least 3 years past the end of the project or the end of any grant supporting the project, whichever is longer.

PREOPERATIVE CARE

Baseline anesthetic parameters (temperature, pulse, respiration, mucous membrane color) and any abnormal findings are recorded. The attending veterinarian is consulted when significant abnormal findings occur. Only healthy animals are cannulated. Food is withheld for 24 hours and water for 12 hours. Lactating cows may have food and water removed from the rumen at the time

of rumenal incision in lieu of withholding food and water so that ongoing milk production is not severely affected.

OPERATIVE PROCEDURE

1. The surgical procedure is performed with the animal in a standing position using appropriate aseptic technique. The cow is restrained in a chute with a head catch, or stanchion attached to a stocks for the duration of the procedure.
2. Sedation and analgesics are administered as described in SOP "Sedation and Analgesia of Ruminants". Be careful not to over sedate the animal. Over sedation will cause the animal to lie down and prevent proper placement of the cannula.
3. The animal is prepared for a left flank laparotomy as described in SOP "Preparation of a Mammal for Surgery".
 - a. The left flank is clipped widely from the area of the lateral processes of the lumbar vertebrae dorsally to the mid-abdominal region ventrally, and from the area of the 11th to 12th ribs rostrally to the point of the hip (tuber coxae) caudally.
 - b. The cannula is positioned at the surgical site as far dorsally in the paralumbar fossa as possible while allowing the cannula edge to fit under the transverse processes of the lumbar vertebrae. The inner circle of the cannula is traced on the side of animal with a permanent ink marker as a guide for the skin incision.
 - c. A reverse 7 line block or paravertebral block is applied as specified in the SOP "Ruminant Anesthesia" at the preference of the anesthetist.
 - d. A surgical scrub is performed.
4. Surgical drapes may be hung over the lumbar region and extended ventrally on each side of the animal around the surgery site, but are only beneficial during the initial stages of the surgery prior to penetration of the rumen. Once the rumen has been penetrated the surgical site, instruments, and surgeon are no longer sterile, although appropriate aseptic techniques should continue to be followed.
5. Once the anesthetic has taken effect, a full thickness skin incision is made along the pre-drawn line; starting at the ventral edge of the circle and cutting dorsally prevents blood from obscuring the line; the skin is elevated from the body wall and excised. A perfectly round incision of a diameter the same size as the cannula or slightly smaller will reduce the likelihood of rumen contents leaking post-operatively.
6. If not cut during excision of the skin, the capsule of the external abdominal oblique muscle is incised the length of the incision in the caudoventral direction following that of the muscle fibers. The muscle fibers are bluntly dissected to expose the internal abdominal oblique muscle. Wide dissection is essential to allow adequate exposure for cannula placement. The fascia and capsules between the external and internal abdominal oblique muscles are incised. The internal abdominal oblique fibers run cranioventrally and are bluntly dissected to expose the transverse abdominal muscle. Wide dissection is again advantageous. The transverse abdominal oblique is elevated with a pair of tissue forceps and incised to prevent nicking the rumen. The incision is expanded dorsally and ventrally in the direction of the fibers using scissors or a scalpel to allow sufficient room for insertion of the cannula.



7. Insert a loop of umbilical tape into the rumen wall leaving a large enough loop to use as a handhold. An assistant or a towel clamp can be used to hold the loop while performing the remainder of the rumenotomy closure. More than one loop may be placed to better support and expose the rumen.



8. The rumen is incised vertically in the center of the body wall incision. The cut edge of the rumen is inverted and the rumen wall sutured to the body wall using a continuous inverting suture pattern with slowly absorbable suture to prevent contamination of the peritoneal cavity and muscle layer of the body wall with rumen contents. 3-4 continuous sutures should be used rather than one so that if the suture breaks the entire suture line does not come undone. Suturing should begin at the bottom of the incision and progress up both sides with the top being closed last to reduce the likelihood of rumen contents being introduced into the peritoneal cavity. Rinsing of the exposed muscle and skin with sterile saline or lactated Ringer's solution is performed as needed to keep the body wall clean. Care must be taken to not allow contaminated fluid to enter the peritoneal cavity. A small quantity (5-10 ml) of long-acting penicillin may be spread directly on the muscle layer as it is closed to prevent infection.
9. The cannula is inserted according to the manufacturer's instructions.



Post-Operative Care

Animals are evaluated twice daily for the first 24 hours post-operatively, then daily for 7 days. The attending veterinarian is consulted if an animal has significantly reduced feed or water consumption, body temperature greater than 104° Fahrenheit, significantly elevated heart or respiratory rates compared to the pre-operative baseline values, unusual restlessness, depression or other signs of abnormal behavior, or if problems with the suture line occur.

Analgesics are continued for 3-7 days post-operatively as needed for pain. Parenteral antibiotics are not required unless contamination of the peritoneum or body wall occurred during the surgical procedure. Any drainage from the surgery site is cleaned daily with water a mild disinfectant soap and water or non-irritating disinfectant solution. Lactating cows are milked twice daily throughout the recovery period.

Animals are evaluated by the attending veterinarian 5-7 days post-operatively if no problems have occurred.

Cannula Maintenance

Fly tags are attached directly to the outer cannula lip in non-lactating animals or lactating animals that will have milk discarded during the fly season. Cannulas are checked for leakage not less than once per week and animals cleaned if needed. Persistently leaking cannulas will be replaced with larger cannulas or washers added to try and reduce leakage. Cracked and dry rotted cannulas no longer functioning properly will be replaced within 30 days.

References

1. Techniques in Large Animal Surgery. A. Simon Turner, C. Wayne McIlwraith. Lea & Febiger. 1982.
2. Bar Diamond – <http://www.bardiamond.com>