

## A Two-Stage Rumen Cannulation Technique in Sheep

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**Abstract:** This experimental study was carried out to describe and evaluate a modified two-stage technique of rumen cannulation in sheep. Ten healthy, castrated, Makoyee sheep with no previous history of gastrointestinal dysfunction were chosen. The surgical technique was performed in two stages. In the first, a 5-cm vertical incision was made in the mid paralumbar fossa. The incision was continued through the subcutaneous. Then the muscular layers of the abdominal wall were divided in the grid technique. The dorso-lateral portion of the dorsal sac of rumen was anchored to the skin by application of four interrupted horizontal mattress suture at 4 points circumferentially using No. 1 silk. In the second, the exposed rumenal wall was incised longitudinally at the mid part of the stay sutures. A rubber-sheep cannula was inserted into the opening and then fixed with an external elastic washer. To augment the cannula stability, the inner flange was also reinforced with a tough rubber washer. All the sheep had normal behavior and appetite during the experiment. In the follow up period no local inflammation, infection, hemorrhage, tissue flap necrosis, wound dehiscence; and suture abscess encountered in the surgical site. Neither evidences of anorexia, toxemia, septicemia and peritonitis were detected. No sign of intra peritoneal infection was observed on inspection of carcasses. The sheep did not lose weight significantly and the cannulas remained permanent fixed in position in 9 cases. This modified ruminal cannulation technique could be considered as a useful alternative with less failure and no more adverse consequences. Furthermore, the technique might be recommended to veterinary scientists who deal with experimental studies on sheep nutrition and husbandry.

**Key words:** Rumen, cannula, two-stage, sheep

### INTRODUCTION

Ruminal cannulation (fistulation) is a surgically created fistula between the dorsal sac of the rumen and the body surface in the left paralumbar fossa. The techniques of rumenal cannulation have been developed for experimental purposes, as well as for the relief of chronic bloat. The experimental techniques are used for quantitative studies of digestion in the rumen, whereas the therapeutic techniques provide temporary symptomatic relief of chronic ruminal tympany (Turner *et al.*, 1989).

Rumen cannulation is performed by either a single-stage technique or a two-stage method (Dougerty, 1981; Lumley *et al.*, 1990). In a two-stage method, either the intact rumen wall can be sutured to the skin along the edge of a laparotomy incision to form an adhesion between the rumen and the skin (Dougerty, 1981) or the method involves applying a metal clamp to a fold of the rumen wall exteriorized through a laparotomy incision and

then allowing a fistula to develop by gradual necrosis and sloughing of the fold and adhesion of the rumen to skin (Hecker, 1974). Then the rumen cannula is inserted and fixed in the opening.

In sheep, rumen cannulation is frequently performed in a single-stage method (Dougerty, 1981; Hecker, 1974; Dougerty, 1955; Thfault *et al.*, 1975). The two-stage procedure is usually recommended for cattle, but this technique has been used by other researchers in sheep as well (Philipson *et al.*, 1939; Quin *et al.*, 1938).

In general, the major drawbacks in experimental ruminal fistulation are how to incise the abdominal wall and how to stabilize the cannula in place during the experimental period. Moreover, infection and peritonitis are the most important surgical complications that may possibly lead to severe crisis and death. In sheep, due to weakness of the body wall musculature, fixation of the cannula and keeping its stability could be considered as a challenging entity among veterinary surgeons who are involved in research-oriented practices. Since

improvement of the conventional techniques might result in enhancing the prognosis for stability of the cannula, this study was designed to describe and evaluate a modified two-stage technique for ruminal cannulation in sheep accordingly.

## MATERIALS AND METHODS

Ten healthy, Makoyee sheep (mean weight  $50 \pm 5$  kg, mean age 10-11 months old), with no previous history of gastrointestinal dysfunction were used in this study. They were received anti parasitic drug therapy and castrated in a non-surgical method a month before the study. The healthy status of the animals was confirmed based on clinical examinations and hematological tests. The animals were fed a diet consisting of lucerne hay, wheat bran and barley with a ratio of forage to concentrate 60:40 (DM basis), which was calculated to provide maintenance. The experimental protocol was approved by the Veterinary Clinical Sciences Committee of Urmia University. This study was a part of the research-based M.Sc. theses submitted to the Animal Husbandry Dept. of Faculty of Agriculture of Urmia University. The surgical technique was performed in a modified two-stage method. All sheep withheld from food and water 12 h before the surgery. The sheep were sedated by intramuscular administration of xylazine Hcl (Rumpon®, Bayer, Germany) ( $0.2 \text{ mg} \cdot \text{kg}^{-1}$  B.W.), and were restrained on operation table in the right lateral recumbent position. Following preliminary skin preparation, the skin and the musculatures of the left flank region were anesthetized with 2% lidocaine Hcl (Lignocaine and Adrenaline Inj., NORBROOK® Co., Northern Ireland) in inverted L block. The skin was prepared for aseptic surgery and draped. In the first stage, a vertical skin incision was made in the mid paralumbar fossa extending from four cm ventral to the transverse processes of the lumbar vertebrae for a distance of 5 cm. The incision was continued through the delicate subcutaneous tissue, and the muscular layers of the abdominal wall were divided in the grid technique. The external abdominal oblique muscle, internal abdominal oblique muscle, and transverse abdominal muscle were dissected bluntly along the direction of its fibers. The dorsal sac of rumen was exposed after sharp incision of the parietal peritoneum. The dorso-lateral portion of the sac was then grasped with a pair of forceps and pulled through the abdominal wall incision. Accordingly, this portion was anchored to the skin by application of four interrupted horizontal mattress sutures using No. 1 silk. The tak sutures were inserted at 4 points (3, 6, 9 and 12 o'clock) circumferentially and passed full thickness through the

ruminal wall and the skin. All the sheep were received  $10 \text{ mg} \cdot \text{kg}^{-1}$  of body weight oxytetracycline Hcl (Oxyvet® Razak, Iran) intramuscularly as a systemic antibiotic and the same preparation as local spray for five consequent days as postoperative care.

In the second stage, at five days postoperative when the wound epithelialization takes place, sheep were physically restrained in right lateral recumbent position. Then the exposed rumen wall was incised longitudinally at the mid point between the cranially and caudally placed tak sutures for a distance of 5 cm. The rubber-sheep cannula was inserted manually into the opening and fixed with an external elastic washer. To augment the cannula stability, the inner flange was also reinforced with a tough rubber washer.

Before the insertion, the cannula was soaked in hot water to make it more flexible. Daily cleansing of the fistula and wound irrigation with diluted povidone-iodine, as the main post surgical care of the sheep in this stage was done for five consequent days.

Postoperative follow-ups were made during two weeks and two years after the second stage of operation. The probable presence of immediate surgical complications, i.e., local bleeding, infection, tissue necrosis and systemic disorders were noted up to two weeks after surgery. Long term presumptive drawbacks, i.e.: loss of the body weight and stability status of the cannula was also drawn into consideration during a period of two years. To confirm the health status of the sheep, jugular blood was taken two times during the first 2 weeks postoperative and monthly afterward to examine blood profiles. Upon the end of experiment, the sheep were slaughtered and the abdominal cavities were inspected for any signs of intraperitoneal abnormalities.

## RESULTS

Ten sheep were fitted with a rumen cannula in a modified two-stage technique. All the sheep in short and long-term follow ups had normal behavior and appetite. The presumptive complications were not encountered during the first 2 weeks postoperative. No signs of local inflammation, infection, hemorrhage, tissue flap necrosis, wound dehiscence, and suture abscess in the surgical site were seen during the follow up period. It was probably due to the adequate adhesion formed between skin and rumen during 5 days after the first stage of operation. In addition, according to the clinical observations and results of the blood tests, no evidences of anorexia, toxemia, septicemia and peritonitis were detected throughout the experiment period.

In the long-term observations, the sheep did not lose weight significantly and the cannulas remained fixed in position in 9 cases. In one case, fistula opening did not have sufficient holding ability to keep the cannula in place permanently. No sign of intraperitoneal infection was observed on inspection of the carcasses.

## DISCUSSION

Fistulated ruminants are valuable in researches concerning ruminant nutrition and physiology (Thyfaul, 1975). Sheep as small ruminants are commonly fitted with rumen cannula for experimental quantitative studies of digestion. The stability of the cannula in the rumenal opening is a necessary demand throughout these controlled experiments that must have least detrimental effect on the animals gastrointestinal functions.

The results of this study were encouraging and showed that the modified two-stage technique in creation of rumen fistula could be a worth-while experiment for permanent placement of rumenal cannula in sheep.

Generally accepted, application of two-stage technique of rumenal cannulation in comparison with single-stage technique might reduce the risk of surgical infection. In the modified two-stage technique being evaluated in this study, irrespective of introducing the sutures in the mucosal membrane of rumen, no obvious infection was observed. The interval between two stages of this operative technique seems to be responsible for initiation of adhesions created between the skin and rumen wall. This tissue seal has an advantage that prevents any leakage of ruminal fluid into the muscular layers and peritoneal cavity. However, gentle manual insertion of the cannula in the second stage of operation is mandatory to preserve local fresh adhesions. Lack of undesired local wound complications and relevant systemic disorders throughout the short time follow up in this study might be due to the appropriate surgical technique applied.

It seems blunt dissection of the abdominal muscles in their fiber directions in comparison with the standard sharp incision might preserve the tonicity and strength of the divided muscles. This surgically-reformed muscular structure takes a valve-like action (Turner *et al.*, 1989). The function of this reconstructed structure might offer a better fitting of cannula in its position in comparison with the traditionally-created opening.

As a general rule, the proper length of the abdominal incision is decisive in fitting the fistula in the second stage of operation. The longer the size of the opening, the more increased the possibility of cannula instability. Furthermore, the loosen cannula not only causes a

detrimental effect on rumen fermentation but also leads to ruminal ingesta discharge, which makes appearance of the operated region undesirable. In shorter sized opening, the cannula insertion would be technically troublesome hence, extreme care must be taken to preserve the fistula intact as the vigorous manipulation of the adhered rumen wall might lead to soft tissue trauma and wound dehiscence.

The weight and size of inner flange are important for providing cannula stability (Mc Sweeney, 1989). In this study, the size and weight of the cannula are improved by using a relatively tough and thick inner washer. Although this improvement strengthened thickness of the interior flange of the cannula and subsequently resulted in permanent cannula stability but as the external part of the cannula still remained flexible, it could bend easily if the sheep catches the barrel on some object in the pen (Dougherty, 1981). Technical failure occurred in one sheep of this study could be due to suture disruption and wound dehiscence at the lower edge of the opening.

Time-consuming process of all two-stage ruminal cannulation techniques is a major disadvantage, which should be drawn into consideration of the veterinary surgeons. Moreover, in the mentioned techniques it is a necessity that the second stage to be operated exactly on the proposed definite time line. The earlier the second stage is done the higher the possibility of wound dehiscence. If it is done later than the recommended time line, the chance of fistula opening stricture and difficulty in cannula insertion would be increased.

Almost all ruminal cannulas leak and must be adjusted frequently (Dougherty, 1981). Accordingly, it is also advisable to clean the exterior flange and the body wall around the cannula repeatedly and adjust it tightly if needed to prevent dislodgement. In our study, the laparotomy incisions were started too close to the uppermost point of the flank to reduce the ruminal leakage around the cannula. Gupta and others (Gupta *et al.*, 1990) in 1990 showed that the position of the laparotomy incision in calves can affect the rate of rumenal fluid leakage from the fistula. They demonstrated when the laparotomy incisions are made parallel to the transverse process of the lumbar vertebrae (horizontal incision) the ruminal seepage is less than the vertical incisions, which made parallel to the last rib. It might be resulted from a higher level of the horizontal incision.

## CONCLUSION

Based on the results of this study, it is believed since in this modified technique cannula failure is virtually eliminated and no crucial adverse consequences are seen,

it might be considered as a useful alternative method for rumen cannulation in sheep. Thus, the technique could be recommended to veterinary scientists who deal with experimental studies on sheep nutrition and husbandry.

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