One-step laparoscopic abomasopexy for correction of left-sided displacement of the abomasum in dairy cows

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Since publication of what appears to be the first report of left-sided displacement of the abomasum in a cow, several surgical techniques for correction of left-displaced abomasum (LDA) have been described. Currently, the surgical techniques used for the correction of LDA in dairy cows include left paralumbar abomasopexy, right paralumbar omentopexy, with or without a so-called pyloropexy, and the blind roll-and-tack procedure. All these techniques have their inherent advantages and disadvantages. The potential drawbacks of laparotomy include recurrence of LDA, local or diffuse peritonitis, incisional infection, incisional dehiscence, abomasal fistulation, duration of procedure, milk loss as a result of administration of antimicrobials and subsequent milk withdrawal. Recurrence of abomasal displacement in dairy cattle was determined to be the most common reason to perform a second surgery. The potential drawbacks of the blind roll-and-tack technique include the lack of opportunity to explore the abdominal cavity, no visual control of repositioning and fixation (including misplacement) of the abomasum, and high recurrence of the condition. Local or diffuse peritonitis and abomasal fistulation. Furthermore, operator skill and experience are determinants in the success of the blind roll-and-tack procedure.

Laparoscopic abomasopexy (LA) has been recently described. The 2-step LA technique (as originally described by Janowitz) was developed to reduce the incidence of complications associated with traditional laparotomy and the blind roll-and-tack corrective techniques. The 2-step LA technique offers the advantages of laparoscopy and the blind roll-and-tack technique, without the disadvantages associated with the latter. The 2-step LA technique combines the minimal invasiveness and visual control for abomasal positioning and fixation offered by laparoscopy with the speed of completion and minimal invasiveness associated with the blind roll-and-tack technique.

In the 2-step LA technique, toggle bar placement within the abomasal lumen is first accomplished with laparoscopic guidance via the left paralumbar area in a standing cow, followed by laparoscopic suture retrieval via the right paramedian area while the cow is in dorsal recumbency. We hypothesized that LA could be successfully performed via the right paramedian area as a 1-step technique. The purpose of the study reported here was to describe a 1-step LA technique for correction of LDA in dairy cows.

Procedures
A diagnosis of LDA was made in 4 dairy cows during the first 2 weeks of the postparturient period; cows were examined either on the farm or in the university hospital clinic. All 4 cows were client-owned; prior to each procedure, informed client consent was obtained. Cows with LDA typically have considerably reduced appetite and consequently decreased rumen fill; therefore, withholding of food prior to the laparoscopic procedure was not required. Xylazine hydrochloride (0.05 mg/kg [0.023 mg/lb], IV) was administered to each cow to provide sedation, and the cow was positioned in dorsal recumbency. The hair in the right paramedian region was clipped with a No. 40 blade, and the skin was scrubbed with a povidone-iodine solution (7.5%) and cotton gauze (4 × 4 inch) and with isopropyl alcohol and cotton gauze (4 × 4 inch). To provide local anesthesia at each of the sites at which the stab incisions would be made to create the laparoscopy portals, a local infusion of 2% lidocaine hydrochloride (5 mL) was administered by use of an 18-gauge, 1.5-inch needle and a 6-mL syringe. By use of a No. 10 scalpel blade, a viewing portal was made 5 cm lateral from the midline and 20 cm caudal from the xyphoid process and an instrument portal was made 5 cm lateral from the midline and 10 cm caudal from the xyphoid process. Because the commercially available LA equipment is marketed as a field set for private practitioners to use on farms, a sterile surgical drape was not used (to mimic field conditions). Preparation time (the time required for positioning of the cow, for aseptic preparation of the right paramedian area for the laparoscopy approach, and for administration of local anesthesia) was recorded for each cow.

An 11.5-cm-long cannula (external diameter, 9 mm; internal diameter, 8 mm) was used as the viewing endoscope; this cannula and a 17.5-cm-long sharp trocar (7 mm in diameter) were bluntly introduced through the stab incision used for the viewing portal (Figure 1). The sharp trocar was removed, and a 41-cm-long viewing endoscope (7 mm in diameter) was placed through the cannula. An endoscopy camera was...
attached to the viewing endoscope and connected to a viewing monitor (as a teaching aid for veterinary students); the procedure was recorded on videotape. An endoscopy light source was connected to the viewing endoscope to provide illumination. The abdominal cavity was insufflated with carbon dioxide (maximum pressure, 15 mm Hg) by use of an automatic insufflator to permit adequate visualization of the abdominal viscera. Once the abomasum was located, an 11-cm-long instrument cannula (external diameter, 7 mm; internal diameter, 6 mm), a 17-cm-long sharp trocar (5 mm in diameter), a specialized 32.5-cm-long cannula (external diameter, 5 mm; internal diameter, 4 mm), a 36-cm-long sharp trocar (4 mm in diameter), and a 36.5-cm-long push rod (3 mm in diameter).

Figure 1—Equipment used to position a viewing endoscope in a portal created in the right paramedian area of a cow with left-displaced abomasum (LDA) during a 1-step laparoscopic abomasopexy (LA) procedure. From left to right, the instruments are an 11.5-cm-long cannula (external diameter, 9 mm; internal diameter, 8 mm), a 17.5-cm-long sharp trocar (7 mm in diameter), and a 0° 41-cm-long viewing endoscope (7 mm in diameter).

Figure 2—Equipment used in the correction of LDA in a cow during a 1-step LA procedure. From left to right, the instruments are an 11-cm-long instrument cannula (external diameter, 7 mm; internal diameter, 6 mm), a 17-cm-long sharp trocar (5 mm in diameter), a specialized 32.5-cm-long cannula (external diameter, 5 mm; internal diameter, 4 mm), a 36-cm-long sharp trocar (4 mm in diameter), and a 36.5-cm-long push rod (3 mm in diameter).

Figure 3—Photograph of a toggle bar suture (length, 4 cm; diameter, 3 mm) used in a 1-step LA procedure to correct LDA in a cow. Two 80-cm-long sutures are attached to the toggle bar at its midpoint. Notice the location of the preset marker (4.5 cm from the toggle bar, which is used as a visual aid (as suture is withdrawn from the abdomen) to enable correct positioning of the abomasum adjacent to the body wall.

had a dyed preset marker located 4.5 cm from the suture-toggle junction, which would be used to indicate that the abomasum had been pulled adjacent to the body wall. The toggle bar was inserted into the abomasal lumen by use of the cannula and push rod. The push rod was removed, leaving the cannula in place to passively deflate the abomasum. The excess suture material was withdrawn up to the preset marker (thereby indicating that the abomasum was adjacent to the body wall) and tied over a gauze stent (Figure 4). The abdomen was then deflated, and the portals were closed by use of polyamide suture (6 metric) in a simple interrupted cru-
The time to complete the LA procedure (ie, the interval between stab incisions and closure of the laparoscopic portals) was recorded, and the cow was returned to a standing position. Antimicrobials were administered only if a concurrent disease process warranted their administration. For each cow, the sutures were removed by the owner 2 weeks after surgery. Two weeks after the LA procedure, owners of the cows were contacted by telephone to determine short-term outcome (rated as excellent, good, or poor). Outcome was based on comparison of the cow’s milk production 2 weeks after LA with that of the herd; outcome was considered excellent when the cow’s milk production was greater than the mean value for the herd, good when the cow’s milk production was the same as the mean value for the herd, and poor when the cow’s milk production was less than the mean value for the herd.

Results
Four dairy cows with naturally occurring LDA underwent a 1-step LA procedure. Among the 4 cows, there were 3 Holsteins and 1 Jersey. One cow was primiparous and had edema of the ventral aspect of the abdomen at the time of surgery. The remaining 3 cows were multiparous and did not have edema of the ventral aspect of the abdomen at the time of surgery. For each cow, history was taken and a physical examination was performed including assessment of heart rate, respiration rate, and temperature; urine ketone testing; rectal examination; simultaneous auscultation and percussion of the abdomen; and evaluations for mastitis (California mastitis and black plate testing). A clinical diagnosis of LDA was made on the basis of the history and physical examination findings, specifically the detection of a high-pitched resonant ping during simultaneous auscultation and percussion over a large portion (> 30 cm in diameter) of the cranial half of the left paralumbar fossa (in an area that extended cranioventrally under the left costal arch to the ninth intercostal space).

Overall, LDA was successfully corrected by use of the 1-step LA technique in all 4 cows. There were no difficulties encountered with respect to patient restraint or positioning for the procedure. The right paramedian approach provided excellent visualization of the abomasum, pylorus, ventral body wall, and diaphragm. All cows returned to milk production following correction of LDA. None of these cows had recurrence of LDA during their subsequent lactation.

For the 4 cows, mean ± SD preparation time was 10.2 ± 1.7 minutes and time to complete the LA procedure was 12.1 ± 2.4 minutes. The mean total time required for preparation and completion of the procedure was 22.4 ± 1.2 minutes. Accidental placement of the cannula through the viewing portal into the omental bursa prior to inflation of the abdomen in 1 cow initially caused the surgeon some viewing disorientation; the cannula was withdrawn from the omental bursa, and the LA procedure was completed without further incident. The preexisting edema of the ventral aspect of the abdomen in the 1 primiparous cow made it physically difficult to perform the ventral laparoscopy.

Three of the 4 cows had preexisting conditions at the time of surgery: 1 cow had fatty liver disease, 1 had ketosis and metritis, and 1 had chronic luxation of the hip joint and toxic metritis. The former 2 cows were those in which problems were encountered during the LA procedure. All 3 cows with concurrent disease received antimicrobials after the procedure. The cow with chronic luxation of the hip joint underwent correction of LDA because it had given birth 2 weeks prior to diagnosis of LDA and the owner desired to attempt milking despite lameness associated with degenerative joint disease of the hip joint. In addition, this cow also had a toxic metritis as a result of retained fetal membranes. Because this cow was a poor surgical candidate and could not stand long enough for traditional laparotomy approaches, the 1-step LA procedure was chosen because of its minimal invasiveness and speed of completion. Although this cow recovered from metritis following LDA correction, it failed to ambulate sufficiently and failed to return to normal milk production as a result of lameness; outcome in this cow was rated as poor. Among the other 3 cows, overall outcome (based on milk production) was considered excellent in the cow with LDA only and good in the 2 cows with LDA and concurrent disease.

Discussion
Although the treatment group size was small, there were sufficient repetitions to develop the 1-step LA technique and successfully correct LDA in all 4 cows. The 1-step LA technique was simple and efficient; compared with the 2-step LA procedure described by Janowitz,19 it was completed with fewer incisions and required less time and less specialized equipment (the 51-cm-long grasping forceps used in the 2-step LA was not required). Furthermore, the 1-step procedure did not require special attention to maintenance of surgical instrument sterility between toggle placement and suture retrieval procedures, as required during the 2-step LA procedure. Via the 1-step LA procedure, adequate visual identification of the abomasum for repositioning and suture placement was ensured on all occasions, unlike the blind roll-and-tack technique.

Accidental insertion of the cannula into the omental bursa during insufflation of the abdomen occurred...
in 1 of the 4 cows that underwent the 1-step LA procedure. The laparoscopic view within the omental bursa momentarily caused some visual disorientation and minor delay; however, the viewing cannula was withdrawn from the omental bursa, and the LA procedure continued without further incident. This minor intraoperative complication may be more likely to occur with the 1-step LA technique because the abdomen is not insufflated prior to inserting the viewing portal, whereas in the 2-step LA procedure, a Verres needle is used to inflate the abdomen prior to inserting the viewing portal for toggle placement. Entering the omental bursa with the viewing cannula could be avoided by use of a Verres needle prior to placing the viewing portal or by use of an endoscope to visually confirm the extramural positioning of the viewing cannula prior to insufflation.

The original 2-step LA technique required 2 procedures for toggle placement and suture retrieval, which involved 2 skin preparations and surgical approaches. Additionally, special attention was required to maintain the sterility of the surgical instruments between toggle placement and suture retrieval procedures. We have used the 2-step LA technique in several cows with LDA, and in our experience, the procedural (preparation and surgical) time was typically 42 minutes. Therefore, a more simplified technique was developed in an effort to address these issues associated with the original 2-step approach described by Janowitz. Nevertheless, there are 2 specific advantages of the 2-step LA technique: the opportunity to confirm the diagnosis of LDA and the ability to evaluate adhesions between the abomasum and the left body wall or the rumen.

The blind roll-and-tack technique for correction of LDA described by Grymer and Sterner is essentially a 1-step procedure that requires placing the cow in dorsal recumbency and blindly placing a toggle into the abomasal lumen. A success rate of 73.3% was initially followed by an 88% success rate in a later study by the same authors; the mortality rate was 13.3% in the first study and 6% in the second study. None of the deaths that occurred after surgery were associated with the procedure. All the cows in the first study and 50% of the cows in the second study had concurrent diseases including ketosis, mastitis, metritis, and retained fetal membranes. Initially, the blind roll-and-tack technique was recommended for use in either old cows or cows with several concurrent diseases when laparotomy was not considered economically feasible. Results of later studies indicated that this technique could be used as an alternative to laparotomy in any cow with LDA. Operator skill and experience are determinants in the success of the blind roll-and-tack procedure to correct LDA in cows; however, mild to severe complications associated with this technique can occur. These complications include the lack of visual control of abomasal repositioning and fixation (including misplacement), high recurrence rate of LDA, local or diffuse peritonitis, and abdominal fistulization. Although the apparent complication rates are low, the complications in cows are generally sufficiently severe to drastically affect their milk production or be a cause of their premature removal from the herd. Pyloric obstruction has been reported after toggle fixation. Close observation of cows after fixation of the abomasum is recommended because clinical signs of suspected abomasal outflow problems secondary to toggle fixation can develop within 48 hours after LDA correction. In instances of suspected abomasal outflow problems secondary to toggle fixation, the external knot may be cut to release the toggle sutures. By combining laparoscopy with the principle of the blind roll-and-tack technique, the lack of visual control associated with the blind roll-and-tack technique is eliminated while the advantages of speed of completion and minimal invasiveness provided by both procedures are maintained. Therefore, the 1-step LA could potentially be an alternative technique for routine correction of LDA in cows.
age to these vessels increased surgical time and resulted in subcutaneous hematoma formation and development of hemoperitoneum.

Laparoscopy can be performed in healthy cows without adverse effects. The laparoscopic appearance of anatomic features of the bovine abdomen has been described. The left paralumbar fossa approach typically provides excellent visualization of the left cranial portion of the abdomen, including the diaphragm, spleen, rumen, left kidney, and the small intestine; occasionally, the pancreas, spiral colon, and bladder can be adequately seen. In contrast, the cranioventral approach typically provides visualization of the cranioventral portion of the abdomen, including the diaphragm, rumen, reticulum, abomasum, pylorus, spleen, and, sometimes, the left liver lobe. In the present study, the right paramedian approach provided excellent laparoscopic visualization of the abomasum, pylorus, ventral body wall, and diaphragm. This laparoscopic view made it possible to accurately place the trocar and position the abomasum adjacent to the body wall; however, visual examination of the entire abdominal cavity was not possible.

The 1-step LA technique described in this report is not limited to a veterinary teaching hospital environment because the equipment requirements could be minimized for field use. The minimum laparoscopic equipment required includes the instrument and viewing cannulas, trocars, push rod, viewing endoscope, light source, portable air pump, and the protective carrying cases. At present, this equipment is marketed in Europe and North America as a field set for private practitioners for use at farm sites. Furthermore, courses designed to acquaint private practitioners with use of the equipment are presently offered. In our study, the laparoscopic procedure could be successfully performed by a person working alone, although assistance was required to position and maintain the cow in dorsal recumbency; however, such assistance is similar to that required to position and restrain a cow with LDA to undergo either traditional right paramedian abomasopexy or blind roll-and-tack procedure at a farm site.

In the event that a cow receives a misdiagnosis of LDA and correction is attempted, the 1-step LA technique offers the potential advantage that an LA could still be performed. This then raises the possibility of performing prophylactic LA in heifers of breeding age. Prophylactic use of LA on farms that have high rates of LDA among cows may reduce the frequency of adverse effects or complications associated with LDA correction in cows during the early postparturient period.

Although only 4 cows were used to develop the 1-step LA technique, it is our opinion that this was a sufficient number of animals in which to develop and describe a surgical technique; however, results of our study cannot be used to evaluate the long-term success of the described 1-step LA procedure. Nevertheless, the 1-step LA technique was a simple and efficient method of LDA correction that was successful in all 4 dairy cows; intraoperative complications were minor, and postoperative complications were not detected. The 1-step LA technique may be a useful alternative to the 2-step LA, the blind roll-and-tack, and traditional laparotomy techniques for routine correction of LDA in dairy cows.

a. Dr. Fritz LLC, Veterinary Endoscopy America, Louisville, Ky, and Spectrum Surgical Instruments Corp, Tow, Ohio.
c. Sony Trinitron 21 monitor, Sony Corp, Ichimiyama, Japan.
e. Solos Endoscopy RAP-II (rapid automatic pneumoperitoneum), Solos Endoscopy Inc, Atlanta, Ga.
f. Jones J, General Manager, Dr. Fritz LLC, Veterinary Endoscopy America, Louisville, Ky: Personal communication, 2004

References


