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Simplified Laparoscopic-Assisted Prophylactic Gastropexy in 40 Client-Owned Dogs

Luca Formaggini*, Mariangela De Franco, Daniela Nulty, Giulia Boi

Clinica Veterinaria Lago Maggiore, Animalia srl Group, C.so Cavour, Dormelletto, Italy
Email: *lformaggini@cvlm.it

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Abstract

Background: Gastric dilatation-volvulus (GDV) syndrome in dogs is a potentially fatal condition that can currently only be prevented surgically. The goal of prophylactic gastropexy is to secure the pyloric antrum to the right abdominal wall, preventing cranial and leftward displacement of the pylorus. Among the various surgical techniques described, minimally invasive approaches are currently preferred. This study presents a simplified technique for laparoscopic-assisted prophylactic gastropexy (LAG). **Methods**: A case series study was conducted on 40 client-owned dogs to assess the feasibility (*i.e.*, the likelihood of successful completion) and efficacy of a modified laparoscopic-assisted prophylactic gastropexy (LAG). The original Rawlings video-assisted technique (2001) involves an incisional gastropexy with laparoscopic assistance, requiring exteriorization of part of the antral gastric wall, incision of the stomach to expose the gastric mucosa, and subsequent suturing seromuscular layers of the stomach to the transversus abdominis muscle. Additionally, the abdominal musculature encountered during the surgical approach—caudal to the last rib and lateral to the rectus abdominis muscle—is incised. In the modified technique described herein, a more delicate grid approach was used for muscle dissection, and both stomach exteriorization and gastric wall incision have been avoided. This modification aimed to reduce invasiveness and potentially minimize postoperative pain. The efficacy of this modified gastropexy in preventing GDV was assessed based on the presence of adhesions between the transversus abdominis muscle and the pyloric antrum. Adhesion formation was evaluated via ultrasound at 1, 3, and 6 months postoperatively. The technique was considered effective if ultrasound confirmed adhesion formation and if no cases of GDV occurred throughout the study period. Intraoperative and postoperative complications, as well as any occurrence of GDV, were also recorded and analyzed. **Results:** At the scheduled follow-up evaluations at 1 and 3 months, all dogs (n = 40; 100%) examined via ultrasound demonstrated adhesion formation at the gastropexy site.

At the 6-month ultrasound follow-up, 32 dogs (80%) were re-evaluated, and all exhibited persistent adhesions. The owners of the eight dogs that missed the 6-month ultrasound check were contacted by telephone to gather follow-up information. None of these dogs exhibited any signs suggestive of GDV or other postoperative complications, further supporting the short-term efficacy and safety of the procedure. No intraoperative complications occurred, and no cases required conversion to open surgery, confirming the feasibility of the procedure. Minor and self-limiting skin wound inflammation was observed in seven dogs (17.5%) within the first 5 to 10 days postoperatively. **Conclusion:** Based on the obtained results, the modified laparoscopic-assisted gastropexy appears to be effective in creating adhesions between the abdominal and gastric walls, with no higher complication rate than other described laparoscopic-assisted gastropexy techniques and with reduced soft tissue manipulation. Furthermore, during the telephone follow-up, none of the dogs exhibited signs of GDV one year post-surgery. Given these findings, this technique may be considered a viable alternative to both video-assisted and the more technically demanding fully laparoscopic gastropexies.

Keywords

Canine Gastric Dilatation/Volvulus, Gastric Disease, Gastric Obstruction, Prophylactic Gastropexy, Video-Assisted Gastropexy, Laparoscopy, Surgery

1. Introduction

Canine gastric-dilatation volvulus syndrome (cGDV) is a potentially fatal disease characterised by gaseous distention and rotation of the stomach around its long axis. This syndrome is associated with varying degrees of hypovolemic or distributive shock, ventilation-perfusion mismatch, and myocardial dysfunction. GDV's pathophysiology and risk factors are extensively described elsewhere [1]-[7]. Briefly, large and giant breed deep chested dogs are more susceptible to GDV and potential risk factors to develop the disease are represented by genetics, fearful or aggressive behaviour and a diet based on a single daily meal. Moreover, for certain breeds, considering the risks of developing GDV during their lifetime and the benefits of the preventive procedure compared to treating an acute episode of cGDV with its associated risks of mortality, prophylactic gastropexy is strongly indicated [8]. Non-surgical interventions to prevent cGDV such as modifying dog's lifestyle or using medications have not been successful, and currently prophylactic gastropexy is considered by far the procedure of choice [8] [9].

By gastropexy for the prevention of GDV, we refer to the creation of adhesions between the pyloric antrum and the right abdominal wall, which requires the disruption of the serosal surface of both structures to facilitate adhesion formation. In general, minimally invasive surgical gastropexy can be classified in two main groups: laparoscopic-assisted (LA) and totally intracorporeal (TI), depending on

whether the entire procedure is being accomplished with or without stomach exteriorization, respectively. Several LA gastropexy (LAg) and TI gastropexy (TIg) techniques along with their advantages and disadvantages have been reported [10]-[19]. Dogs undergoing the TIg technique seem to show less post-operative pain but, they tend to have longer surgical times [10] and more skills are required of the surgeon for TI compared to LA surgeries; it means that surgeons require a training in intracorporeal suture techniques (*i.e.* hand suturing or endo-stapler or other endoscopic suturing devices) and potentially they must be efficient in dissection techniques when performing TIg.

In particular, Rawlings' technique [20], the first described laparoscopic-assisted gastropexy, involves making an incision in the muscular layers of the right abdominal wall—caudal to the last rib and lateral to the rectus abdominis muscle. A portion of the pyloric antrum is then exteriorized, and a sutured incisional gastropexy is performed by attaching the stomach to the transversus abdominis muscle after incising the serosa and gastric muscular layers.

In the technique we describe, the muscles of the abdominal opening are not incised but carefully dissected, and the stomach is neither exteriorized nor incised. Instead, it is secured to the right abdominal wall using transabdominal sutures. Therefore, the authors believe that this procedure may be less invasive than the previously described technique.

The aim of this prospective case series is to describe the feasibility (intended as the probability of completing it successfully) and the efficacy of the modified technique in a series of client-owned dogs presenting for elective prophylactic gastropexy. Feasibility was defined as the ability to perform the procedure without the need for conversion and the efficacy was assessed in term of adhesion formation and absence of symptoms of GDV in the follow-up period. The presence of adhesions between pyloric antrum and transverse abdominal muscle was evaluated by means of ultrasound (US) as previously reported in other studies [16] [21] [22].

Our hypothesis was that the modified Lag technique would be feasible and effective with similar complications to those reports of traditional Lag method.

2. Materials and Methods

Inclusion criteria for this clinical trial consisted of dog breeds at risk for GDV syndrome presenting for prophylactic gastropexy. Exclusion criteria were dogs presented for concomitant laparoscopic ovariectomy, dogs that had any previous symptoms related to GDV and owner who refused a priori to return for scheduled ultrasound checks. Each case had to be accompanied by a signed written consent form, clearly explaining the new technique and its differences from previously described methods. All dogs underwent preoperative assessment including clinical, serum biochemical and hematological evaluation prior to surgical intervention.

Surgical technique: the anesthetic and analgesic protocol was selected by the anesthetist based on individual patient needs. However, apart from minor indi-

vidual variations, the general protocol adopted was as follows: premedication consisted of Dexmedetomidine (4 mcg/kg) and Methadone (0.2 mg/kg), administered intramuscularly. Once sedation was achieved, a 20G venous catheter was placed. Anesthesia was induced with Propofol (3 mg/kg IV), followed by endotracheal intubation and maintenance with Isoflurane (ET 1.2%) in a 50%/50% O_2/Air mixture.

Throughout the procedure, continuous monitoring of heart rate (HR), respiratory rate (RR), end-tidal CO_2 ($ETCO_2$), oxygen saturation (SpO_2), non-invasive blood pressure, and temperature was performed. All patients underwent mechanical ventilation in volume-controlled mode.

Postoperatively, Meloxicam (0.2 mg/kg SC SID) was administered, and owners were instructed to continue Meloxicam (0.1 mg/kg PO) for an additional three days at home.

The surgery was performed by a single surgeon (LF) with laparoscopic experience, assisted by a second operator.

Dogs were positioned in dorsal recumbency, and the abdomen was clipped and prepared as standard for celiotomy. Two portals were used in each case. The telescope portal (5 mm) was placed 2 - 3 cm caudal to the umbilicus on the linea alba and served for abdominal insufflation. A 5 mm, 0˚-angled telescope was then introduced, allowing for a brief abdominal exploration.

Subsequently, a ~5 cm skin incision was made parallel to the costal arch at a predetermined point, 3 - 4 cm from the costal arch, starting laterally to the rectus abdominis muscle belly. The incision included the skin and subcutaneous tissue, while the oblique muscles were bluntly dissected along their fibers until the transversus abdominis muscle was exposed but not incised (Figure 1).

Figure 1. The oblique muscles were bluntly dissected parallel to their fibers, until the transversus abdominis muscle was visible but not incised. Dog is in dorsal recumbency. Cranial is toward the upper left corner.

Under laparoscopic guidance, a second (10 mm) cannula was inserted through the center of the skin incision and the dissected muscle fibers into the abdominal cavity (Figure 2). A 10 mm endo grasper was introduced through the working

cannula, allowing the pyloric antrum to be grasped and gently pulled toward the cannula. Once the stomach contacted the cannula, both the cannula and forceps were drawn against the abdominal wall. At this stage, the cannula was withdrawn from the abdomen, partially reducing the pneumoperitoneum (Figure 3).

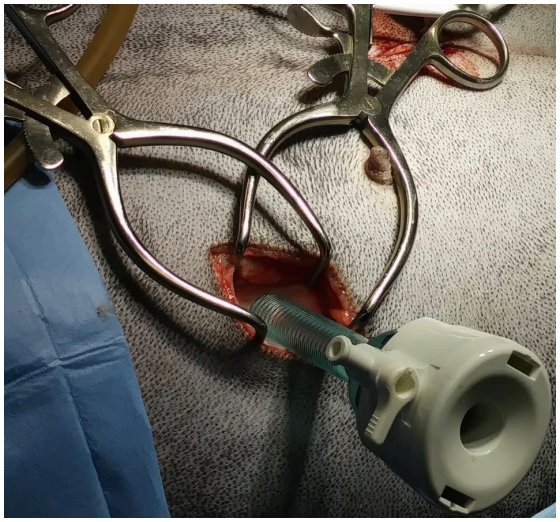


Figure 2. A second cannula (10 mm) was then inserted in the abdomen under laparoscopic vision through the center of the incision and the dissected muscles fibres. Dog is in dorsal recumbency. Cranial is toward the upper left corner.

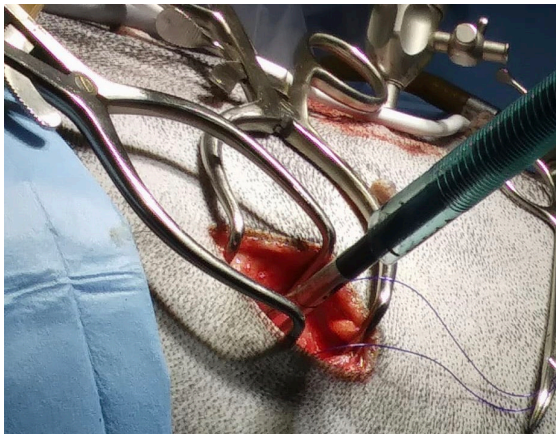
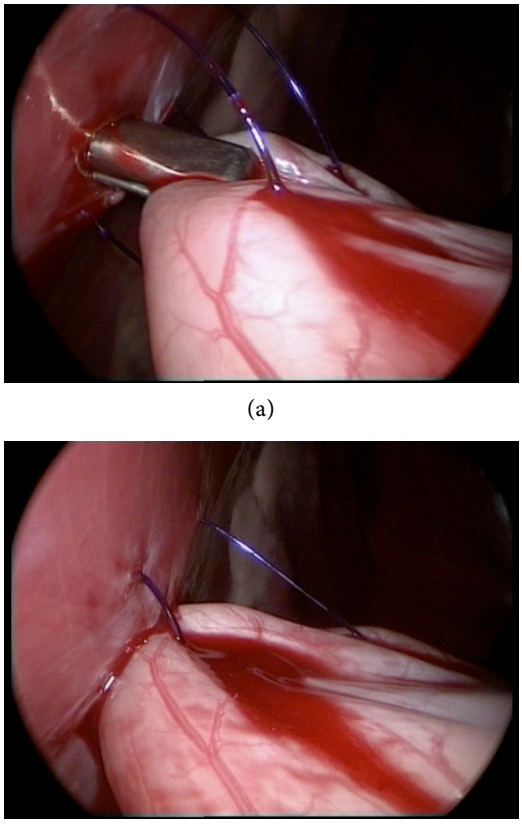


Figure 3. After the antral wall of the stomach was grasped, both the cannula and the forceps were withdrawn adjacent to the body wall. Dog is in dorsal recumbency. Cranial is toward the upper left corner.

The grasped antral seromuscular fold remained inside the abdomen, and transabdominal sutures were placed under laparoscopic guidance using 2 - 0 polydioxanone (Figure 4(a), Figure 4(b)). An interrupted suture pattern was applied, consisting of three to four single sutures spaced 1 cm apart. Each suture bite included the transversus muscle/fascia, the gastric seromuscular fold, and again the transversus muscle/fascia. No attempt was made to scarify the seromuscular layer of the stomach before suturing.



(a)

(b)

Figure 4. The antral seromuscular fold is left inside the abdomen and trans-abdominal sutures (polydioxanone 2 - 0) were positioned under laparoscopic view between the stomach and right abdominal wall. Telescope portal is in the umbilical area. The dog in dorsal recumbency.

At the end of the procedure, the oblique muscles were loosely approximated, while the subcutaneous tissue and skin were closed routinely. Skin incisions were covered with a sterile sponge and adhesive non-woven fabric.

All dogs were discharged on the day of surgery after confirming their ability to function independently. Postoperative therapy consisted of anti-inflammatory treatment with meloxicam *per os* once a day for three days. No antibiotic therapy was continued beyond a single prophylactic injection administered before induction.

To protect the surgical wound, owners were advised to use an Elizabethan collar or a surgical body suit until wound healing and suture removal. Additionally, they were instructed to restrict the dog's activity (avoiding running, jumping, or other vigorous exercise) for four weeks post-discharge. The dogs' regular diet was maintained, with the precaution of dividing the daily food intake into three meals for one week.

Clinical follow-up was scheduled five days after surgery for wound assessment and ten days postoperatively for suture removal. During these visits, owners were asked about the immediate postoperative period, specifically regarding vomiting

or regurgitation, pain, and mobility.

Ultrasound examinations were planned at 1, 3, and 6 months postoperatively to evaluate the gastropexy site for adhesions, in accordance with previously published studies [16] [21] [22].

A single veterinarian (MDF) performed all ultrasound examinations. The probes used included a 6.6 MHz microconvex probe (evaluation depth: 4 cm) and a 7.5 MHz linear probe (evaluation depth: 2.5 - 3 cm). All examinations were conducted with the patient in a standing position, without sedation. Images were obtained parallel to the ground and aligned with the right last rib at the level of the third distal segment.

Post surgical complications were classified as minor if self-limiting or major if surgical intervention was required.

3. Results

Forty client-owned dogs met the inclusion criteria. Of these, 22 were males and 18 females. The represented breeds included Great Dane (9), German Shepherd (9), Weimaraner (2), Pitbull (2), and one each of Rhodesian Ridgeback and Czechoslovakian Wolfdog. Sixteen dogs were mixed breed, displaying phenotypic characteristics predisposing them to GDV (e.g. deep-chested conformation).

The mean age was 25.8 months (range: 6 - 72 months), and the median weight was 37.3 kg (range: 25.5 - 70 kg). No dogs required conversion to laparotomy, and no intraoperative complications occurred. The median surgery time was 43 minutes (range: 38 - 52 minutes).

Seven cases developed minor complications: five cases of wound infection/inflammation and two cases of seroma. Both seromas were self-limiting, while wound infections/inflammations were managed with topical medications. All complications involved the skin wound at the gastropexy site and became evident within seven days post-surgery, resolving completely within two weeks. No major complications were observed.

At the 5-day clinical check-up, five owners (12.5% of dogs) reported behaviour interpreted by the attending veterinarian as nausea in the first 24 hours post-intervention; nevertheless the appetite was preserved; this symptom resolved spontaneously without pharmacological treatment in all five dogs.

Ultrasound findings: thirty-two dogs (80%) underwent US examination at 1, 3 and 6 months postoperatively; 8 dogs (20%) missed the 6-month US examination but were examined at 1 and 3 months. In all dogs examined by ultrasound, the gastropexy site was confirmed by the presence of adhesions between the gastric and abdominal walls, identified as hyperechoic tissue interfaces consistent with fibrotic attachment; the hyperechoic interface length as measured at US evaluation ranged between 2.5 to 4 cm (median 3 cm).

4. Discussion

Our results suggest that this modified LAG technique is safe and effective in dogs,

with only minor and transient postoperative complications observed in seven cases (17.5%). In the authors' opinion, the main advantages over the traditional laparoscopic-assisted technique include reduced tissue dissection/injury and improved accuracy in the placement of the second trocar. Nevertheless, a few dogs developed minor postoperative skin wound complications at the gastropexy site. These findings align with recent studies reporting wound complications associated with the LAG technique in 19% to 30% of cases [9] [23]. Possible causes of skin incision inflammation, infection, and seroma may include disruption of tissue planes (e.g., abdominal muscles) and movement at the surgical site. Additionally, self-trauma (e.g., licking or scratching with the hind limb) may have contributed, particularly in one of the dogs in our study. However, as ultrasound examinations confirmed adhesion formation in all cases, none of these complications had a negative impact on the expected outcome (*i.e.*, gastropexy adhesion).

Hypersalivation and chewing were reported by the owners of five dogs (12.5%), with symptoms resolving spontaneously without pharmacological treatment. This phenomenon may not be directly related to the surgical technique but rather to the altered anatomical position of the pylorus following gastropexy, as previously described [24], or to the anesthetic event or other unidentified, unrelated factors.

This technique closely resembles Mathon's technique [11]; however, our approach utilizes a grid dissection through the fibers of the oblique abdominal muscles to isolate only the transversus abdominis muscle with its fascia. This modification facilitates what we subjectively found to be easier suture needle penetration through both the abdominal and gastric walls. Additionally, unlike Mathon's technique, our method requires only two portals instead of three.

Adhesions were achieved between the gastric wall and the wound left by the 10 mm cannula placed on the transversus muscle, without the need for intentional scarification of either tissue. In the technique described here, no specific measures were taken to prevent suture penetration into the gastric lumen, and postoperative gastroscopic evaluation was not scheduled, making this a potential, albeit unlikely, complication. However, previous studies have demonstrated that when the stomach is grasped and lifted by fingers or a grasper, the gastric mucosa naturally separates from the seromuscular layer, significantly reducing the likelihood of lumen penetration [11] [25]. Furthermore, our ultrasound examinations did not reveal any abnormalities at the gastropexy site, such as localized effusion, perforation, or suture penetration.

Lastly, the use of only two portals and the incomplete incision of the abdominal wall may contribute to reduced postoperative pain. At the time of discharge, all dogs appeared subjectively pain-free, and owners did not report any behaviors indicative of overt postoperative pain. However, it remains uncertain whether the dogs in our study experienced less pain compared to those undergoing other LAG or totally intracorporeal (TI) techniques, as this outcome was not objectively assessed. A future study evaluating objective pain parameters, such as validated pain scales, would be valuable in further assessing this aspect.

Our study has several limitations: first, the relatively small sample size may limit the generalizability of our findings. Second, since all surgeries were performed by the same surgeons with laparoscopic experience; in this case, the concept of feasibility may be influenced by the surgeon's experience. A novice operator—considering that video-assisted gastropexy is generally regarded as a basic procedure—might encounter difficulties in performing it. However, this aspect was not investigated in our study, and therefore, the learning curve for this procedure remains unknown, as do its potential complications during the initial learning phase. Additionally, the absence of a control group prevents direct comparisons regarding surgical time, postoperative pain, and complications. However, the study design as a case series inherently limits such analyses and conclusions.

Another limitation is the lack of histological examination of the gastropexy site and its tensile strength, a common constraint in clinical studies involving client-owned dogs (no dogs died during the study period). However, the exact force required to displace the stomach under natural conditions remains unknown. Therefore, while mechanical testing may indicate that one gastropexy technique is stronger than another, its clinical relevance remains uncertain. The authors believe that in clinical studies, it is essential to rely on the least invasive methods to verify adhesion formation and to monitor patients over time for any signs of GDV. In this study, both of these criteria were met. Supporting this perspective, Mathon *et al.* (2009) conducted a study on experimental dogs using a gastropexy technique similar to the one described here. Their results showed mechanical strength comparable, though slightly lower, to previously published data. Given that our technique involves complete disruption of the transversus muscle layer rather than mere peritoneal surface cauterization, we can speculate that the adhesion strength achieved may be similar or even superior.

5. Conclusions

The laparoscopic-assisted gastropexy technique described in this report offers some theoretical advantages over the original Rawlings technique [20]. The careful blunt dissection of the oblique muscles using a grid approach provides two key benefits: it allows for more precise localization of the cannula insertion site and may reduce postoperative pain. In contrast, the Rawlings technique involves blindly placing the port, with muscle transection dictated by its location, rather than a controlled blunt dissection.

Another potential advantage is that the stomach is neither exteriorized nor incised. Instead, the antral wall is gently brought into apposition with the abdominal wall at the site of the working cannula insertion. This approach facilitates gastropexy between the portal access wound in the transversus abdominis muscle and the antral fold of the stomach, potentially minimizing tissue trauma while ensuring secure adhesion formation. Based on the obtained results, the modifications to the original video-assisted gastropexy technique appear to be effective in creating stable adhesions between the abdominal and gastric walls, with a complication

rate comparable to other laparoscopic-assisted gastropexy techniques. Additionally, these modifications allow for less invasive and more precise soft tissue manipulation.

None of the dogs in this study exhibited symptoms related to GDV during the established follow-up period, supporting the possible efficacy of this modified approach in preventing gastric dilatation-volvulus.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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