Gastric dilatation–volvulus (GDV) is a syndrome characterized by rapid accumulation of gas or food in the stomach, increased intragastric pressure and wall tension, and rotation of the stomach about its long axis. Gastric distention unleashes a series of potentially lethal pathophysiologic events, the most important of which are compression of the portal and caudal vena caval venous blood flow, gastric necrosis, tissue acidosis, cardiac arrhythmia, disseminated intravascular coagulation, and hypotensive and cardiogenic shock. For dogs that develop GDV, surgical correction is strongly recommended. Among those dogs, mortality remains high (15% to 33%), even with aggressive resuscitative management.

A gastropexy is the creation of a permanent adhesion between the gastric antrum and the adjacent right body wall. Failure to perform a gastropexy at the time of surgery for GDV correction results in a >50% recurrence rate, whereas performing a prophylactic gastropexy during corrective surgery for GDV decreases the recurrence rate by 4% to 10%. As a result, gastropexy is now considered the standard of care. Several open surgical gastropexy techniques have been described: tube, circumcostal, belt loop, muscular flap, gastrocolopexy, and incisional. Because of the high mortality rate associated with the development of GDV, these procedures may be used prophylactically in dogs that have not had GDV but are considered to be at high risk.

Studies have indicated that a prophylactic gastropexy can result in a twofold to 30-fold reduction in lifetime mortality associated with GDV for rottweilers and Great Danes, respectively.

Recent advances in veterinary medicine have included a move toward more mini-

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Dr. Rawlings discloses that he has received financial support from Biovision, Covidien, Ellman International, Endoscopic Support Services, and Karl Storz Veterinary Endoscopy.

TO LEARN MORE

For a detailed description of abdominal access using a Veress needle or the Hasson technique, see the August 2008 Surgical Views article, “Canine Laparoscopic and Laparoscopic-Assisted Ovariectomy and Ovariectomy.” This article is available at CompendiumVet.com.
mally invasive procedures, and the use of laparoscopic surgery for creating a less invasive prophylactic gastropexy has been investigated. These techniques can be performed in isolation or in conjunction with surgical sterilization. Laparoscopic-assisted, laparoscopic, and endoscopic gastropexy techniques have proven successful. The clinical outcome of a reported laparoscopic-assisted gastropexy indicated a persistent attachment between the stomach and the body wall with few complications and effective prophylaxis against GDV development. Studies reveal that an intracorporeally sutured laparoscopic gastropexy can be performed safely and effectively and has less impact on the dog's postoperative activity level than a laparoscopic-assisted gastropexy. However, the adhesion strength and long-term outcome of the intracorporeally sutured laparoscopic technique have not yet been evaluated. In this article, we describe the techniques for laparoscopic-assisted and laparoscopic gastropexy.

**Risk Factors for Gastric Dilatation–Volvulus**

A breed predisposition has been demonstrated for Great Danes, German shepherds, standard poodles, Weimaraners, Saint Bernards, Gordon setters, Irish setters, bassett hounds, Airedale terriers, Irish wolfhounds, borzois, bloodhounds, Akitas, and bull mastiffs. Large, risk factors for GDV have been demonstrated for several breeds.

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**QuickNotes**

Predisposition to GDV has been demonstrated for several breeds.

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**Overview of the Veress Needle and Hasson Technique for Obtaining Abdominal Access**

The Veress needle has a blunt-tipped, spring-loaded stylet within a sharp-tipped needle. As it is advanced through the body wall, the sharp tip penetrates the abdominal musculature; once within the peritoneal cavity, the spring-loaded protective stylet is deployed, thus minimizing risk of iatrogenic organ damage when the abdominal cavity is penetrated. Peritoneal insufflation can then be performed through the needle, followed by trocar placement.

The Hasson technique uses a blunt cannula in a trocar–cannula assembly that is passed through a very small incision, usually created in a subumbilical location. Once the peritoneum has been sharply penetrated, the trocar–cannula assembly is advanced into the abdomen, pointing to the right side to minimize the risk of splenic laceration. If a 5-mm telescope and instrumentation are used, a 6-mm trocar–cannula assembly should be placed first.
mixed-breed dogs are also predisposed. Various non–breed-associated risk factors have been shown to be associated with GDV. Nondietary risk factors include lean body condition, older age, male sex, increased thoracic depth-to-width ratio, first-degree relative with GDV, aggressive or fearful temperament, histologic evidence of inflammatory bowel disease, and increased hepatogastric ligament length. Dietary risk factors that can lead to the development of GDV include food characteristics—small food particle size and the presence of oil or fat among the first four ingredients of a dry food—and feeding practices or behaviors, including feeding a large amount of food, once-daily feeding, feeding from an elevated bowl, eating quickly, and aerophagia. Based on these risk factors, it may be reasonable to conclude that certain canine subpopulations are at such a high risk of developing GDV that they could be considered good candidates to receive prophylactic treatment.

**Laparoscopic-Assisted Gastropexy**

To perform a laparoscopic-assisted gastropexy, place the dog in dorsal recumbency and clip and aseptically prepare the abdomen from the xiphoid cartilage to the brim of the pubis. Abdominal access can be obtained by use of a Veress needle or the Hasson technique (BOX 1). If the Hasson technique is used, a blunt cannula must be employed for initial port placement. If a pneumoperitoneum has already been established through the use of a Veress needle, a sharp cannula can be used for this purpose.

A pneumoperitoneum is usually established with carbon dioxide, using a mechanical insufflator that allows controlled insufflation and intraabdominal pressure monitoring. The intraabdominal pressure measured with the insufflator should not be allowed to exceed 10 to 15 mm Hg while the trocars are placed; it should then be reduced to 6 to 8 mm Hg, or just sufficient to maintain an optical space, during the laparoscopic portion of the gastropexy. Place a 0° or 30° 5-mm laparoscope through the subumbilical port, just lateral to the right margin of the rectus abdominus and 3 to 5 cm caudal to the last rib (FIGURE 1). The second trocar-cannula assembly should be large enough to accommodate 10-mm instrumentation.

Transilluminate the incision site to identify and avoid abdominal wall vessels. Nerves parallel vessels; thus, avoiding the vessels reduces the risk of hemorrhage and nerve injury. Pass a 10-mm laparoscopic Babcock or DuVall (FIGURE 2) forceps through the instrument port to manipulate the cranial abdominal organs and obtain an unobstructed view of the antrum of the stomach. Then grasp the

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**QuickNotes**

Dietary risk factors that can lead to the development of GDV include food characteristics and feeding practices or behaviors.
The antrum of the stomach is grasped using 10-mm Babcock or DuVall forceps.

antrum of the stomach with the forceps midway between the mesenteric and antimesenteric sides, approximately 5 to 7 cm oral to the pylorus (FIGURE 3). This is also the site for incisional gastropexy.

Once you have a firm hold on the antrum, evacuate the pneumoperitoneum. Exteriorize the forceps and antrum by removing the right-side cannula and extending the port incision to 4 to 5 cm in an orientation parallel to the last rib. During this dissection, use of a muscle-splitting approach to the external and internal abdominal oblique muscles by incising parallel to the orientation of their fibers may result in less postoperative pain. The transversus abdominis is the final layer to be sectioned before the stomach can be exteriorized. During the antral exteriorization, take care to avoid twisting. As soon as the stomach is visualized, place a full-thickness stay suture of 2-0 absorbable or nonabsorbable monofilament suture in the stomach wall. The forceps can be released at this point. Place a second stay suture 4 to 5 cm orally or aborally. The relative positions of these sutures define the extent of the proposed gastropexy (FIGURE 4).

Make an incision at least 4 cm long through the seromuscular layer of the antrum along the long axis of the stomach, avoiding the larger blood vessels emerging from the greater and lesser curvatures (FIGURE 5). Dissect this incision from the mucosa to ensure that the sutures are not placed through the mucosa into the lumen and that adequate muscle tissue is exposed for the gastropexy. Place two simple, continuous lines of 2-0 or 0 synthetic, monofilament, absorbable suture to appose both margins of the seromuscular layer in the antrum to the transversus abdominis muscle (FIGURE 6).

Before closure, remove the full-thickness stay sutures. Close the oblique abdominal muscles with interrupted or continuous sutures of synthetic, absorbable material, and close the remainder of the incision in routine fashion. After completion, briefly reestablish the pneumoperitoneum and view the gastropexy laparoscopically to ensure that optimal positioning and orientation have been achieved and that excessive hemorrhage or body wall defects are not present (FIGURE 7).

After once more evacuating the pneumoperitoneum, remove the midline cannula and close the incision (FIGURE 8). Closure of any port-site incisions that are 5 mm or larger should include body wall closure to avoid the
possibility of incisional herniation of abdominal viscera.

**Laparoscopic Gastropexy**

**Use of Intracorporeal Stapling Devices**

Place the dog in dorsal recumbency, clip and aseptically prepare the abdomen, and establish a pneumoperitoneum. Place three 10- to 12-mm cannulae in the caudal aspect of the right side of the abdomen. Hold the ventral aspect of the gastric antrum with laparoscopic grasping forceps and make a 2- by 5-cm submucosal tunnel with laparoscopic Metzenbaum scissors and laparoscopic Kelly forceps, using both sharp and blunt dissection. Make a similar-sized tunnel in the adjacent right lateral abdominal wall between the transverse and internal abdominal oblique muscles caudal to the last rib. Insert a 35-mm gastrointestinal anastomosis laparoscopic stapler (Endo-GIA, Covidien Inc, Mansfield, MA) into the dissected tunnels and staple the stomach to the right abdominal wall. You can use a laparoscopic hernia stapler to close the tunnel opening with three to six staples placed individually while apposing the tissues with a grasping instrument; alternatively, a modification of this method has been described in which the imperforate stoma resulting from the anastomosis of the two tunnels was closed with an intracorporeal simple interrupted suture pattern of 2-0 or 3-0 nonabsorbable monofilament suture material.

There are significant disadvantages to an intracorporeally stapled gastropexy. Full-thickness perforation of the gastric wall was seen in 14% of cases in one study. This complication could lead to contamination and abscess formation. This technique can also be associated with prolonged surgical time. A further disadvantage relates to the significant cost of using disposable stapling devices.

**Use of Intracorporeal Suturing**

In this totally laparoscopic technique, the gastropexy is created using intracorporeal suturing techniques alone, which, while requiring rela-
tively little disposable equipment, do require some specific instruments. Apart from routine laparoscopic equipment, two laparoscopic needle holders (Szabo-Berci 5-mm, 33-cm laparoscopic parrot-jaw needle holders, Karl Storz Endoscopy) are needed to complete the suturing successfully.

Establish a camera port in a subumbilical location as previously described, then establish two 6-mm instrument ports on midline, one 3 to 4 cm caudal to the xiphoid process and the other midway between the two other ports and directly medial to the traditional site for open gastropexy (Figure 9).

Pass a length of 2-0 nylon suture on a 38-mm reverse-cutting ¾-circle curved needle percutaneously at the intended site of the gastropexy, 2 to 3 cm caudal to the last rib and 5 to 8 cm lateral to midline. Grasp the needle with a laparoscopic needle holder within the peritoneal cavity and take a deep, full-thickness bite through the antrum of the stomach. Then pass the suture back through the abdominal wall adjacent to its previous point of entry. This stay suture is used as a temporary anchor to appose the stomach to the body wall during incising and suturing.

Make the first incision in the transversus abdominis muscle using laparoscopic Metzenbaum scissors. Then make a partial-thickness incision in the seromuscular layer of the stomach. These incisions should be 4 to 5 cm long and be adjacent to each other in an orientation parallel to the ventral midline (Figure 10).

Introduce an approximately 30-cm length of 2-0 polyglactin 910 suture on a curved or ski-type needle into the peritoneal cavity by passing the needle through the body wall adjacent to the gastropexy site. First, suture the lateral wall of the incisions in the transversus abdominis muscle and antrum using a simple continuous pattern. While tying knots, evacuate the pneumoperitoneum to decrease tension and ensure secure knots and tight suture lines. Once the lateral margins of the incision have been sutured, introduce a second piece of suture and suture the medial margins to complete the gastropexy. Once suturing is complete, remove the stay suture. Close the three midline ports in routine fashion after the pneumoperitoneum has been evacuated.

This technique is more technically challenging than laparoscopic-assisted gastropexy and requires the use of some specialized equipment (i.e., the laparoscopic needle holders). It is more time consuming, but it may be associated with less postoperative discomfort because it avoids the paramedian incision used in the laparoscopic-assisted technique and therefore reduces tissue trauma.13

QuickNotes

Intracorporeal suturing is more technically challenging than laparoscopic-assisted gastropexy.
Conclusion

It is generally accepted that all the laparoscopic techniques described in this article are associated with less tissue trauma and postoperative pain than open celiotomy. All the techniques require the use of basic laparoscopic equipment and some specialized training. We would advise veterinarians wishing to perform these techniques to seek further specialized training. In the case of the totally laparoscopic techniques, some experience with intracorporeal suturing using simulators or cadavers is recommended before performing these procedures on client-owned animals.

References

16. Rawlings CA, Mahaffey MB. Prospective evaluation of laparoscopic-assisted gastropexy in dogs susceptible to gastric dilatation. JAVMA 2002;221:1576-1581.