SURGICAL MANAGEMENT OF BRACHYCEPHALIC SYNDROME

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Key Points

- English bulldogs are significantly over-represented.
- Light general anesthesia is required for accurate evaluation of laryngeal function and defects.
- Limited use of crushing clamps and cautery results in less postoperative swelling.
- Overall prognosis for dogs with brachycephalic syndrome is favorable.

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Definition: Brachycephalic syndrome is a combination of upper airway disorders commonly seen in brachycephalic breeds (e.g., English bulldog, Boston terrier, Pugs). Disorders associated with this syndrome include stenotic nares, elongated soft palate, and everted laryngeal saccules. Occasionally patients present with laryngeal collapse. Patients may present with any combination of the above listed disorders.

Diagnosis

Clinical presentation:

Signalment: Brachycephalic breeds are most commonly affected (i.e., English bulldog, French bulldog, Boston terrier, Pug, Pekingese). The age at presentation ranges from less than one year to 11 years. The majority of patients present between 1 and 4 years with English bulldogs presenting at a younger age than other breeds. There is no apparent sex predisposition.

History: Historical findings are generally related to upper airway obstruction and include noisy respiration, heat intolerance, exercise intolerance, cyanosis, and occasionally syncopal attacks. Gagging, retching, and vomiting may also be reported. Historical findings may vary depending upon the number of abnormalities present (i.e., stenotic nares, elongated soft palate, and/or everted laryngeal saccules). Generally, the more abnormalities present the more severe the historical and clinical findings.

Clinical signs: The most frequently reported clinical signs in patients with brachycephalic syndrome include noisy respirations and exercise and/or heat intolerance. Moderate to severely affected patients or patients with multiple defects may present with cyanosis and/or syncope.

Physical examination: Physical examination is generally normal except for patients with stenotic nares. In patients with stenotic nares the wings of the nostril (i.e., dorsolateral nasal cartilage) obstruct airflow resulting in turbulent airflow and resultant noise.

Examining the patient after exercise may exacerbate clinical signs (i.e., noise and exercise intolerance) making diagnosis of brachycephalic syndrome more likely. Oral examination of the awake patient is generally unrewarding as the laryngeal apparatus

and related abnormalities cannot be seen without light general anesthesia.

Radiography: Diagnosis of brachycephalic syndrome is based on signalment, history, physical examination, and direct visualization of the laryngeal apparatus with the patient under light general anesthesia. Thoracic radiographs are generally recommended to rule out lower airway disorders such as tracheal hypoplasia and pulmonary abnormalities.

Differential diagnosis: Any disorder causing noisy respirations, exercise intolerance, cyanosis, and syncope. Included are laryngeal mass, laryngeal collapse and laryngeal paralysis.

Medical management: Medical management is directed at decreasing airway turbulence and subsequent inflammation and edema. Strict confinement, anti-inflammatory medications (e.g., steroids, NSAIDS), and a cool environment are recommended. Obese patients should be placed on a weight reduction diet plan. As medical management does nothing to change the anatomic deformity of the disorder, it is considered palliative but not curative.

Surgical treatment: The objective of surgical treatment is to provide an adequate airway by relieving any anatomic obstruction.

Preoperative management: Use of anti-inflammatory medication preoperatively is generally recommended. Patients are given intravenous steriods (dexamethasone 0.5 - 1 mg/kg IV) at the time of anesthetic induction.

Anesthesia: Anesthetic management is somewhat dependent upon the severity of clinical signs at presentation and degree of airway abnormality.

Patients with mild signs may be anesthetized with the clinicians' standard anesthetic protocol. Careful evaluation of the laryngeal apparatus is performed prior to intubation and while the patient can still breath on its own (i.e., light general anesthesia). Laryngeal function is carefully evaluated during inspiration and expiration.

Patients with moderate clinical signs may need to be preoxygenated prior to induction. Induction should be performed quickly, the laryngeal anatomy and laryngeal function examined thoroughly, and the patient intubated to establish an open airway.

Patients with severe clinical signs should be preoxygenated 5 - 10 minutes prior to induction. A vagolytic agent (i.e., atropine) should be considered 10 - 15 minutes prior to induction because vagal tone is generally increased and cardio-inhibitory reflexes are enhanced. Induction should be quick, examination of the laryngeal anatomy and function performed, and the patient intubated to establish an open airway.

Laryngeal examination: Once the patient is under a light plain of anesthesia laryngeal function is evaluated. Care is taken to observe for evidence of laryngeal collapse, elongated soft palate, and everted laryngeal saccules.

Surgical anatomy: The soft palate in the dog forms a long and broad movable partition between the oral and nasopharynx. The cranial border is attached to the bony palate; the caudal margin forms the dorsal border of the opening from the mouth into the pharynx. This portion of the palate is in contact with the epiglottis during normal

inspiration; during deglutition, the epiglottis moves away from the soft palate to protect the opening of the glottis. At the same time the soft palate moves dorsally to close the nasopharynx and prevent regurgitation of material into the nasal cavity. The dorsal nasopharyngeal surface has a mucous membrane lining continuous with that of the nasal cavity and a slightly convex contour. The mucous membrane of the ventral concave surface is a continuation of the lining of the hard palate and is referred to as the oral surface of the soft palate.

Relevant pathophysiology: Protrusion of an elongated soft palate into the laryngeal inlet during respiration significantly obstructs air passage into the glottis. Stenotic nares, when present, contribute to the severity of the occlusion by increasing the inspiratory effort (and subsequent negative pressure) thus drawing the soft palate deeper into the larynx. Edema and inflammation result from friction against the epiglottis during each respiration. The resultant thickening further lessens airflow. As increased inspiratory effort continues, increased negative pressure in the airway encourages laryngeal saccules to evert.

Positioning: Patients may be positioned in ventral or dorsal recumbancy.

Stenotic nares: The author prefers ventral recumbancy with the head supported on towels so the head position is normal and functional.

Elongated soft palate and everted saccules: Patients can be operated in either ventral or dorsal recumbancy. In dorsal recumbancy, the maxillary canine teeth are taped securely to the operating table. The mandibular canine teeth are taped to an ether stand situated over the patients' head. The mouth is opened wide to enhance visualization. This positioning is critical as oral cavity exposure is key to adequate visualization and instrumentation.

In ventral recumbancy, the maxillary canine teeth are 'hooked' over the bar of an ether stand. The mandibular canine teeth are then taped to the operating table in such a fashion that the mouth gapes open. The tongue is grasped with tongue forceps and gently pulled from the mouth.

Surgical technique: The surgical technique varies depending upon the defect to be repaired.

Stenotic nares: This technique is illustrated on the Respiratory Surgery I surgery video available via www.videovet.org.

Stenosis is decreased by removing a horizontal wedge of alar cartiladge from the wing of the nostril. The flap created is sutured to remaining tissue of the wing of the nostril using 3-0 or 4-0 Dexon or Vicryl in a simple interrupted suture pattern. Two or three sutures is all that is generally required to complete the nasoplasty.

An alternate technique gaining popularity in Shih Tzu and Boston breeds is to completely excise the alar cartilage. Bleeding is controlled by wedging a gauze sponge in the patient's nostril for 5 minutes by the clock.

Presurgical temporary tracheostomy?: Use of a presurgical tracheostomy facilitates exposure and visualization of the soft palate and laryngeal saccules. However, it is not

necessary in the majority of patients. The author considers use of a tracheostomy in patients that present with severe clinical signs (i.e., cyanosis, syncope) and have a combination of defects to repair. Tracheostomy is preferred over exiting the endotracheal tube through a pharyngostomy as the tracheostomy can be used in the postoperative management of the patient if necessary. In our hospital, regardless of the severity of the airway obstruction, the patient is recovered in a critical care environment and instruments necessary to perform an emergency tracheostomy are readily available.

Elongated soft palate: This technique is illustrated on the Respiratory Surgery I surgery video available via www.videovet.org.

When the patient is anesthetized for surgery, light general anesthesia is performed so the surgeon can visualize the relationship of the soft palate with the epiglottis prior to intubation. Using a skin marker a single 'dot' is placed on the location of the elongated soft palate that touches the tip of the epiglottis (see the video for Soft Palate Resection on the Respiratory Surgery I surgery video www.videovet.org). Once the soft palate is marked the patient can be intubated and anesthetized for surgery.

The patient is placed in ventral (the author prefers ventral recumbacy) or dorsal recumbancy with the mouth opened widely (see positioning). A broad malleable retractor can be used to retract the tongue caudally or a tongue clamp can be used to retract the tongue ventrally; either technique greatly facilitates visualization of the soft palate and laryngeal structures. A headlamp also facilitates visualization but is not necessary.

Since postoperative edema and swelling are of major concern following soft palate surgery, it is important to keep surgical trauma to a minimum. Use of clamps and electrocautery may cause excessive surgical inflammation and should be avoided. Use of a laser has been shown to be an atraumatic alternative to excision and suturing.

When suturing, a 3-0 or 4-0 synthetic absorbable braided suture is recommended (Dexon, Polysorb or Vicryl). Dexon, Polysorb or Vicryl is chosen because of its soft supple nature; Maxon, Biosyn or PDS are much to stiff and may cause irritation to the oral cavity postoperatively.

First, a stay suture is placed in the soft palate on each lateral margin of the proposed soft palate excision. A mosquito hemostat is placed on the stay sutures to apply tension to the palate thus facilitating exposure. The mark on the soft palate is used to help determine stay suture location. A third stay suture is placed on the margin of the central portion of the soft palate. This stay suture allows the surgeon to manipulate the palate during resection. The soft palate incision is begun from the left or right margin (stay suture) and one-third of the soft palate is incised using the 'dot' to determine extend of resection. The incised nasal mucosa is then sutured to the incised oral mucosa using a simple continuous suture pattern. Hemorrhage is controlled by suture pressure. No attempt is made to cauterize or clamp bleeding vessels. Once the first 1/3 of the palate excision is sutured the next 1/3 of the palate is cut and sutured. Staging the excision facilitates the surgeon's ability to visualize the oral and nasal mucosal cut surfaces for suturing. When the palate excision and suturing are complete, the stay sutures are cut and the remaining soft palate replaced and evaluated once again for extent of resection.

Everted laryngeal saccule resection: There is some suggestion that if the stenotic nares and elongated soft palate can be successfully treated (see above), the lateral saccules

will return to their normal location in the larynx and no longer cause airway obstruction without the need for surgical resection. The author only removes lateral saccules in patients that present with severe respiratory signs (i.e., severe cyanosis, syncope).

When removing laryngeal saccules, the patient is placed in dorsal recumbancy with the mouth opened widely. Everted laryngeal saccules appear as edematous, translucent tissue 'balls' lying in the ventral aspect of the glottis and obscuring the vocal folds.

If the patient had a tracheostomy tube placed prior to surgery, the saccules are easily visualized and excised as described above. If the patient has an endotracheal tube exiting the laryngeal apparatus, the tube is temporarily removed while the saccules are excised.

Surgical removal is performed using a sharp long-handled laryngeal cup biopsy forceps (or similar long handled biopsy instrument) or a long-handled Allis tissue forceps and #15 BP scalpel blade. If a laryngeal cup biopsy forceps is used the everted saccule is grasped and amputated with the biopsy forceps. Any remaining tags are grasped with a long-handled DeBakey forceps and trimmed with a #15 BP blade or scissors. If an Allis tissue forceps is used the laryngeal saccule is grasped with the Allis forceps and a long-handled scalpel with a #15 BP blade is used to excise the saccule at its base.

Suture material/special instruments:
Malleable retractors or Young tongue retractor (JorVet.com), head lamp, long-handled laryngeal cup biopsy forceps (or similar instrument), long-handled Allis tissue forceps, long-handled scalpel handle, long-handled DeBakey forceps, 3-0 or 4-0 Dexon, Polysorb or Vicryl with a cutting or sharp taper needle.

Postoperative care and assessment: Any patient requiring surgery to relieve airway obstruction should be monitored carefully (preferably in a critical care environment) for the first 24 hours postoperatively. The degree of care may vary depending upon the patients presenting signs and surgical manipulations required to correct the airway obstruction. Examples of the authors' degree of postoperative care based on patient presentation and surgery performed are listed below:

Stenotic nares only: These patients are generally held for observation 12 – 24 hours postoperatively and discharged from the hospital the day following surgery.

Soft palate resection only: Patients that present with mild clinical signs (i.e., noise, mild exercise or heat intolerance) and are bright and alert 24 hours after surgery can be discharged that day. Patients that present with moderate to severe clinical signs (i.e., severe exercise intolerance, episodes of cyanosis, syncopal attacks) are monitored in a critical care environment until signs resolve. Immediate postoperative gagging and coughing are observed in about 13% of patients. Patients requiring a tracheostomy prior to surgery, or an emergency tracheostomy, remain in a critical care environment until the tracheostomy can be removed.

Combined nares, palate, saccule repair: These patients are treated similarly to patients with soft palate resection and are based on presenting clinical signs. Patients with multiple defects tend to present with moderate to severe clinical signs and may require more intensive care. Immediate postoperative gagging and coughing are observed in about 80% of patients.

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Prognosis: Prognosis for patients with brachycephalic syndrome is generally dependent upon the defects found at presentation.

<u>Stenotic nares only:</u> About 96% of dogs with stenotic nares will improve postoperatively.

<u>Soft palate resection only:</u> About 85 – 90% of dogs with soft palate resection only will improve postoperatively. Young dogs (i.e., less than 2 years of age) are more likely to improve (90%) than dogs greater than 2 years of age (70%).

<u>Stenotic nares and soft palate resection:</u> Dogs having a combination of stenotic nares repair and soft palate resection are more likely to have a favorable outcome (96%) compared to those that did not (70%).

<u>Soft palate and everted saccule resection:</u> Dogs having this combination of defects repaired will have an 80% chance of significant improvement postoperatively.

SURGICAL MANAGEMENT OF GDV

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If you would like a video of this surgical procedure go to **www.videovet.org**.

Key Points

• Survival is generally determined by early and appropriate presurgical management
• Patients referred for surgery should be decompressed prior to referral with continued decompression provided during transport
• Incisional gastropexy results in a fast, easy, permanent adhesion
• Ventricular tachycardia is a common postoperative complication
• Gastric necrosis signals an unfavourable prognosis

Introduction: Patients with GDV are considered critical care cases; every minute of presurgical treatment is vital to a successful outcome. Survival is generally determined by early and appropriate presurgical management and urgent surgery as soon as the patient is stabilized. Efficient presurgical treatment usually involves a minimum of two people. Gastric decompression and shock therapy should be done simultaneously. If this is not possible; decompression should be performed first. It is stated that gastric decompression is the single most important factor in reversing cardiovascular deficits in patients with GDV.

Decompression: Generally, orogastric intubation can successfully be performed in 80 - 90% of GDV patients. If orogastric intubation is unsuccessful decompression via right flank needle puncture is indicated. It is also suggested that right flank needle puncture is recommended as a first attempt at decompression in severely depressed, metabolically deranged patients.

Orogastric Intubation Technique: The stomach tube is measured to the last rib and marked with a piece of tape. A stiff GDV, foal or mare stomach tube with a smooth bevelled tip works best (having several diameter and stiffness tubes is ideal). Apply generous lubrication to the tube. Place a functional mouth speculum; generally a roll of 2" tape secured in the mouth with tape encircling the muzzle. As the stomach tube is passed, you will often meet resistance at the lower esophageal sphincter. Pass the tube firmly in a twisting manner to encourage the tube to pass through the lower esophageal sphincter.

If unsuccessful, place the patient in various positions and attempt to pass the tube (i.e., elevate animal at 45 degree angle with hind limbs on the floor and front limbs on the table, right lateral recumbancy, and left lateral recumbancy). This movement may encourage the stomach to rotate enough to allow the tube to pass into the stomach. Be careful not to position the patient in dorsal recumbancy as this will increase abdominal visceral pressure on the caudal vena cava and thus exacerbate signs of shock.

If still unsuccessful, try different diameter tubes; try a smaller diameter, more flexible tube and proceed as described above.

If still unsuccessful, attempt to remove some of the air in the stomach by placing an l8 gauge needle at the point of distention in the right flank region. Ping the area to make sure the spleen is not under the proposed trocarisation site. After trocar decom-pression, attempt to pass the stomach tube as described above.

If still unsuccessful, sedate the dog with a narcotic (e.g., Oxymorphone) and try to pass the tube again. Mild sedation is recommended if the patient strongly resists physical restraint.

Success in passing a stomach tube depends on the skill of the operator and available assistants.

If you are successful at passing a stomach tube and plan to refer the patient to a referral surgical center for gastropexy, transport the patient with the tube remaining in the stomach (i.e., taped to the mouth) or bring the tube out through a pharyngostomy incision or place a nasogastric tube.

If a stomach tube was successfully passed, stomach contents should be evaluated for color and presence or absence of necrotic looking gastric mucosa. This may give an impression of gastric viability.

Fluids: Shock dosage of polyionic isotonic fluid is carefully administered to expand the vascular compartment. Patients are frequently monitored during fluid administration to help determine ultimate fluid rate and amount. One or two indwelling cephalic catheters are generally placed.

Referral: If you are successful at passing a stomach tube and plan to refer the patient to a referral surgical center for gastric derotation and gastropexy, transport the patient with the tube remaining in the stomach (i.e., taped to the mouth) or bring the tube out through a pharyngostomy as described below.

Pharyangostomy tube placement:
a. Orally palpate the fossa lateral to the hyoid apparatus until a lateral bulge is seen
b. Make a small skin incision over the bulge and press a curved forceps (substitute for finger) through the soft tissues and skin incision.
c. Pull the stomach tube through the incision with curved forceps; then pass the tube over the arytenoid cartilages, down the esophagus, and into the stomach (measure to the 13th rib).

Disadvantages include: heavy sedation or general anesthesia is necessary for placement of the tube.

Rarely a temporary gastrostomy may need to be performed. The patient is placed in left lateral recumbancy with the right flank area clipped and surgically prepared. Heavy sedation and local infiltration of lidocaine or light general anesthesia is performed. A 4 - 5 cm incision is made in the skin over the point of greatest gastric distention (generally 1 - 2 cm caudal to the 13th rib and 2 - 3 cm distal to the transverse processes of the lumbar vertebrae). A grid technique is used to gain entrance into the peritoneal cavity. Due to severe gastric distention the stomach wall is pressed against the abdominal wall and thus easily identified through the flank incision. The stomach wall is sutured to the skin using a simple continuous pattern with 3-0 Maxon. This is done prior to incising into the stomach lumen. A #11 BP scalpel blade is used to puncture into the lumen of the stomach. Gas and stomach contents are expelled under pressure so stand back! The gastric mucosa is evaluated for viability. Disadvantages of gastrostomy include: the stomach is sutured in its rotated position and more time is required when definitive surgical treatment is performed due to the necessity of closing the gastrostomy.

Successful stomach tube placement: Once the stomach tube has been passed into the stomach or gastrostomy performed, the stomach is lavaged with warm water. If a stomach tube was successfully passed, the stomach contents should be evaluated for color and presence or absence of necrotic gastric mucosa. This may give an impression of gastric viability.

Surgical Treatment:
A specific 'Surgical Plan' should be in mind before entering the operating room theatre. This will improve the efficiency of surgery and thus decrease overall surgery time. The 'authors' surgical plan is as follows:

Stand on the right side of the patient.

Provide generous abdominal exposure via xyphoid to pubis midline laparotomy.

Remove of all of the falciform ligament to the level of the xyphoid.

Place a 10'' Balfour self-retaining abdominal retractor (metal frame toward the patients head) with full retraction.

Confirm that the omentum is draped over the exposed surface of the stomach (pathagneumonic for GDV).

Attempt derotation by:
Standing on the patients' right side, first reach your right hand across the abdomen and place it between the left body wall and dilated stomach.
Slide your right hand along the sublumbar body wall and grasp the deep (dorsal) aspect of the stomach at the level of the spine.
Next, place the open palm of your left hand on the exposed surface of the right side of the dilated stomach.
Using both hands simultaneously, pull the deep part of the stomach with your right hand to begin derotation whilst you push the right surface of the stomach down toward the patients sublumbar body wall with your left hand. This maneuver will be successful in the majority of cases.

See this maneuver performed on the Emergency Surgery I, Gastrointestinal Surgery I, and Soft Tissue Surgery II surgery videos available at www.videovet.org.

Once the stomach is derotated, evaluate gastric viability (particularly the greater curvature and fundus) and for evidence of gastric motility.

Next, exteriorize the spleen from the abdominal cavity. Evaluate color, texture, blood flow (splenomegaly is often present and is NOT an indication for splenectomy). Gently palpate the splenic veins for evidence of venous thrombosis. Splenectomy is rarely performed but may be necessary if splenic vessels are thrombosed (veins feel like threads or rubber bands).

If the stomach is full of air or fluid it should be emptied prior to attempting derotation.

If the stomach is full of food and several attempts to derotate (see author's technique above) are unsuccessful, perform a gastrotomy and manually remove the food from the stomach lumen. Suture the gastrotomy and attempt derotation again.

Commence your gastropexy procedure.

Incisional gastropexy: This technique is based on a 3-4cm long seromuscular antral incision sutured to a similar length incision in the transversus abdominus muscle. This is the authors' technique of choice for permanent gastropexy.

With the Balfour retractors still in place visually locate the ideal position for the antral wall incision. It should be located equidistant between the pylorus and gastric incisure and equidistant between the greater and lesser curvature of the stomach. A 4cm longitudinal sero-muscular incision is made in this antral location. An easy way to safely make the sero-muscular incision is to grasp the full thickness antral wall with your thumb and finger at the site of the proposed incision, gently retract the wall of the stomach until you feel the mucosa and submucosa 'slip' out of your thumb and finger. The tissue remaining between your thumb and finger is the sero-muscular layer of the antral wall. Using a straight or curved Metzenbaum scissors cut the tissue remaining in your thumb and finger resulting in a perfect depth of the sero-muscular incision. Extend the incision to a 4cm length and gently undermine the edges to allow generous suture bites in the stomach wall during gastropexy.

Once the antral incision is completed remove the Balfour retractors. When selecting the location on the transversus abdominus muscle for the gastropexy, it is important to first visualize the location of diaphragmatic muscle fibers as they radiate into the abdominal cavity and attach near the costal arch. It is important that the gastropexy site be at least 2cm caudal to the diaphragm muscle insertion. After identifying the attachment of the diaphragm, the bleeding surface of the antral incision is brought to the right body wall. With the stomach in a normal position, the bleeding antral surface is touched to the peritoneal wall approximately 3-4 cm deep to the abdominal wall incision and 2cm caudal to the insertion of the diaphragm. A blood mark is created on the peritoneum at this proposed location. This will be the site for the permanent gastropexy. The peritoneum and transverses abdominus muscle are then incised creating a mirror image defect of the antral incision. The incisional defect in the stomach is then sutured to the incisional defect in the abdominal wall. The defects are sutured in two layers using a simple continuous pattern with 2-0 or 3-0 monofilament or multifilament synthetic absorbable suture.

Belt Loop Gastropexy: This technique is based on the construction of a sero-muscular antral flap attached around a segment of transversus abdominus muscle. A horseshoe shaped incision is made in the serosal layer of the antral portion of the stomach with its base at the greater curvature. The sero-muscular portion of the stomach is identified by grasping full thickness antral wall between the thumb and index finger and "slipping" the mucosal and submucosal layers away so only the sero-muscular portion of the wall remains between thumb and finger. The sero-muscular layer is incised with scissors and the horseshoe shaped sero-muscular antral flap is dissected and elevated of the submucosal layer. The stomach is replaced in the abdominal cavity in normal position and the sero-muscular flap lined up with the transversus abdominus muscle. Once this optimal location is discovered, two longitudinal incisions (along the fibers of the transversus m.) are made in the transversus abdominus m. The segment of muscle between the incisions is undermined. The sero-muscular flap from the stomach (i.e., belt) is passed through the transversus abdominus m. (i.e., loop) and sutured to itself to complete the "Belt-Loop" gastropexy. 2-0 or 3-0 monofilament absorbable synthetic suture in a simple interrupted or continuous pattern is used to secure the flap in place. Advantages of belt loop gastropexy include: it is relatively easy to perform alone and in the middle of the night, it can be performed quickly, and it is an effective means of permanent gastropexy.

Postoperative management

In most cases 3 to 4 days of intensive monitoring is necessary for the successful management of GDV patients. Postoperative considerations are listed below:

a. Shock is a postoperative possibility and the patient should be monitored and treated accordingly.

b. Patients are generally held off food and water for 24 hours following surgery. During this time maintenance fluids should be supplied using polyionic isotonic crystalloid fluid. Vomiting may occur following surgery; the NPO period should be extended accordingly. Gastritis and gastric motility disorder may be seen in post op GDV patients.

c. After 24 hours of no vomiting, oral alimentation should begin gradually with a sequence of ice cubes, water, and finally canned dog food. This should occur over a 2-3 day period.

d. Antibiotics should be continued for 7 - 10 days.

e. Routine surgical complications such as infection, dehiscence, seroma, etc. should be watched for and treated accordingly.

f. EKG monitoring: the most common severe postoperative complication is cardiac arrhythmia. Approximately 75% of GDV patients will develop arrhythmia's in the immediate postoperative period. Arrhythmia's can be present at the initial time of presentation but most often occur within 24 - 72 hours after surgery. Ventricular premature contractions, progressing to ventricular tachycardia is most common. Etiology is unknown but shock, hypoxia, acid base alterations, endotoxins, myocardial depressant factor (MDF), reperfusion injury, release of free radicals, and hypokalemia have been identified.

g. Gastric motility: occasionally GDV patients develop postoperatove gastric motility abnormalities. Patients with gastric hypomotility or gastric stasis noted at the time of surgery should be treated with a motility modifier (i.e., metaclopramide, erythromycin, etc).

Sari H. Touru and Daniel D. Smeak

A practical right-sided incisional gastropexy technique for treatment or prevention of gastric dilatation volvulus

Käytännöllinen oikeanpuoleinen viiltogastropeksia mahalaukun laajentumisen ja kiertymisen hoitona tai ennaltaehkäisynä

SUMMARY

Gastropexy for treatment of Gastric Dilatation Volvulus is often performed as an emergency procedure, therefore, an ideal method for gastropexy should be quick, safe and easy to perform. This article describes an incisional gastropexy technique designed to be readily performed by a surgeon without assistance. Like other successful permanent gastropexy techniques, this method apposes incised surfaces of the right abdominal wall and pyloric antrum. Illustrated technical details are included that allow the surgeon to readily create these incised surfaces while avoiding potential complications such as inadvertent perforation of the gastric mucosa or diaphragm. In addition, standard gastropexy incision sites are described and shown to help prevent gastric malpositioning or outflow obstruction following surgery.

YHTEENVETO

Mahalaukun täyttymisen ja kiertymisen hoitona tehtävä mahalaukun kiinnitys vatsaontelon seinämään joudutaan usein tekemään kiireellisenä toimenpiteenä, jonka vuoksi ideaalisen gastropeksian tulisi olla nopea, turvallinen ja helppo. Tässä artikkelissa kuvataan viiltogastropeksian tekniikka, jonka kirurgi voi vaivattomasti tehdä ilman avustajaa. Viiltogastropeksian avulla mahanportin soppi kiinnitetään pysyvästi vatsaontelon oikeaan seinämään viiltopintojen avulla. Artikkelissa selitetään yksityiskohtaisesti kuvien avulla viiltogastropeksian tekninen suoritus. Oikealla tekniikalla vältetään yleisimmät komplikaatiot kuten mahalaukun limakalvon tai pallean perforaatio sekä mahalaukun virheasennot ja niistä johtuvat ongelmat.

INTRODUCTION

When a dog develops gastric dilatation volvulus (GDV) or has gastric dilatation, simple repositioning of the stomach without a means of pyloric antral fixation to the abdominal wall results in an unacceptably high risk of recurrent GDV (Glickman et al. 1998). Therefore, a right-sided gastropexy is recommended to prevent future bouts of GDV (Fossum 2002, Monnet 2003, Slatter 2003). Prophylactic gastropexy also dramatically reduces the risk of GDV in dogs with a familial history of this condition in first-degree relatives (Ward et al. 2003).

The goal of gastropexy is to create a permanent adhesion in an anatomic position between the stomach antrum and right body wall. Because gastropexy is often performed as an emergency procedure, an ideal method for gastropexy should be quick, safe and easy to perform. Simple suturing of the stomach to the abdominal wall without removing the serosa does not result in permanent fixation (Fossum 2002). It has been shown that raw gastric muscle must be in contact with incised muscle of the body wall long enough for permanent adhesions to form (MacCoy et al. 1982, Wacker et al. 1998). Various gastropexy techniques have been described that incorporate this essential principle. The most currently accepted permanent gastropexy techniques include tube

gastropexy, circumcostal gastropexy, muscular flap gastropexy, belt-loop, and incisional gastropexy (Fossum 2002, Monnet 2003, Slatter 2003, Ward et al. 2003). Recently, a laparoscopic-assisted gastropexy technique has been described (Rawlings et al. 2002, Naim et al. 2003, Slatter 2003).

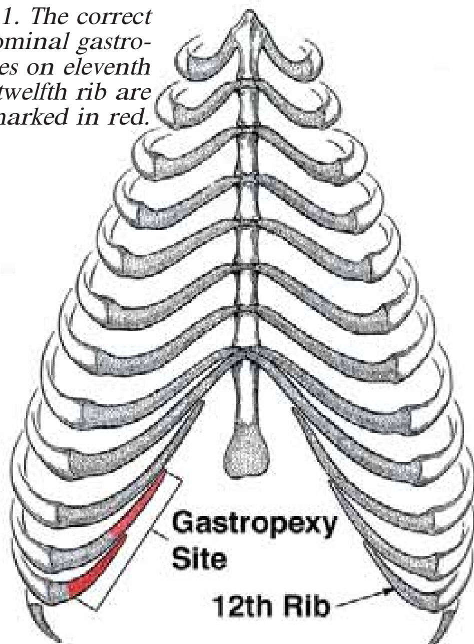
The objective of this article is to illustrate a novel gastropexy technique that incorporates the raw muscle surfaces between the stomach and abdominal wall, and that is very safe and quick to perform in our hands. Incisional gastropexy is one of the easiest of the techniques previously listed, especially for inexperienced surgeons. However, previous descriptions of incisional gastropexy may be somewhat confusing because the gastropexy sites are vaguely illustrated and explained, and this can lead to a number of iatrogenic complications. In this article we chose to use series of pictures of a patient to help illustrate and describe this novel technique so important details can be shown, and the reader can more fully understand the procedure. Potential complications such as unnecessary haemorrhage in the abdominal wall, gastric perforation, malpositioning of the stomach or diaphragmatic disruption, are avoided with this technique. Due to the limited scope of this paper, the authors refer readers to other veterinary sources for important information about the management of patient with this condition (Bojrab 1983, Monnet 2003, Slatter 2003).

TECHNIQUE

With the animal in dorsal recumbency, aseptically prepare the ventral abdomen past the flank folds laterally, and 10 centimetres cranial to the xiphoid extending to the pubis. The surgeon stands on the left side of the patient for the best exposure to the gastropexy site; the figures in this article are viewed from this perspective. Hence, the cranial aspect of patient shown in this series of images is to the right.

Create a linea alba incision from the xiphoid to umbilicus. This incision should be long enough to perform gastropexy and allow complete abdominal exploration. If more cranial exposure is needed in deep-chested dogs, continue to cut the linea incision (cranial but superficial to the xiphoid cartilage) with Mayo scissors. Remove the falciform fat to access the abdominal wall gastropexy site. If the gastropexy is done to treat, rather than prevent GDV, decompress the stomach and reposition the antrum to its normal location. Evaluate the stomach for evidence of necrosis after repositioning. Resect or invaginate necrotic stomach wall as the surgeon prefers (Monnet 2003). Evaluate the spleen for irreversible changes, such as necrosis or venous thrombosis and perform a splenectomy if necessary. Explore the entire abdomen and correct any problems encountered before performing the gastropexy.

Grasp the right side of the cranial abdominal wall incision, evert and roll the wall to allow palpation of the chondral aspect of rib twelve. The twelfth rib can be



igure 1. The correct abdominal gastropexy sites on eleventh or twelfth rib are marked in red.

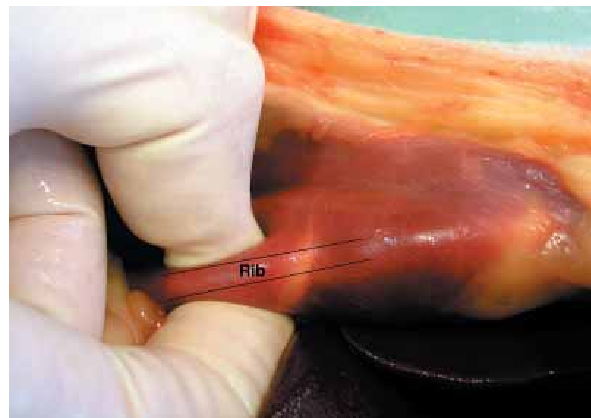
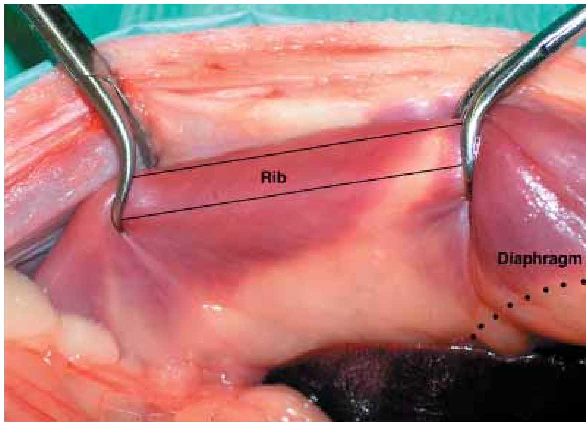


Figure 2. The twelfth rib is palpated and fixed between fingers.



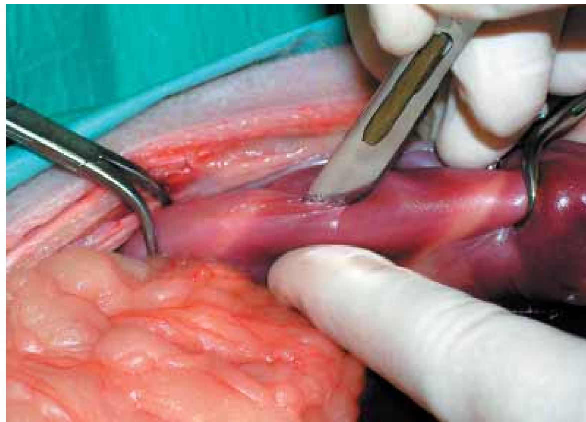


Figure 3. Transverse abdominal muscle is incised on top of the rib which is held by towel clamps.

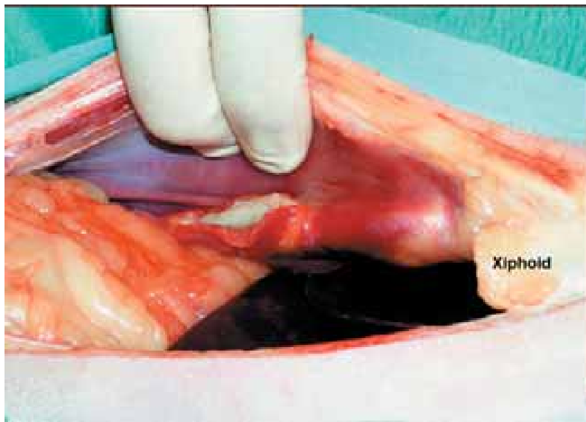


Figure 4. Towel clamps are removed after the incision is completed. Note that the correct site of the incision is several centimetres caudal to xiphoid.

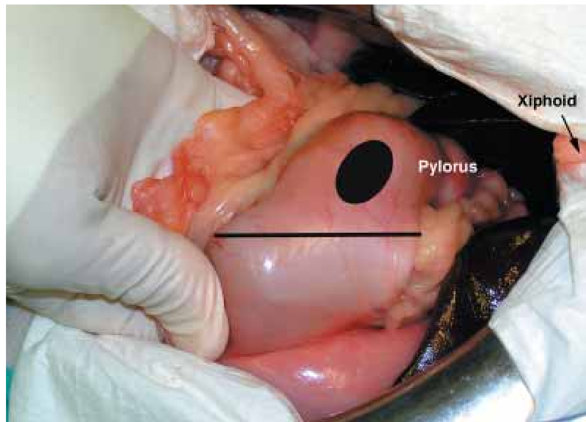


Figure 5. The correct stomach gastropexy site, marked with an ellipse, is midway to the pylorus and lesser curvature line.

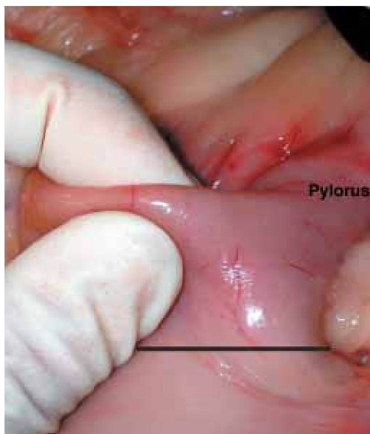


Figure 6. The stomach is pinched between fingers and lifted up to let the mucosa slip away.

identified by palpating its cartilaginous margin that ends several centimetres caudal to the xiphoid cartilage. The reader should note that there are individual breed differences in the location of the chondral aspect of ribs eleven and twelve. The eleventh rib can be used alternatively if the cartilaginous end of this rib is located several centimetres caudal to the xiphoid (Fig. 1). Isolate the twelfth rib with your thumb and index finger and pull the rib away from deeper structures (Fig. 2). Place two towel clamps around the isolated rib approximately five to six centimetres apart from one another. The cranial clamp should be positioned at the end of the twelfth rib approximately several centimetres caudal to the xiphoid (Fig. 1). Elevation of this rib by the towel clamps helps stabilize the rib and retracts it away from the diaphragm. In one stroke, directly incise over the twelfth rib with a scalpel blade between the towel clamps (Fig. 3). The transverse abdominal muscle will separate at once, exposing the cartilaginous rib. This incision can be done safely since the cutting directly over the stabilized rib prevents accidental blade damage to surrounding structures. After the abdominal wall gastropexy incision is completed, remove the

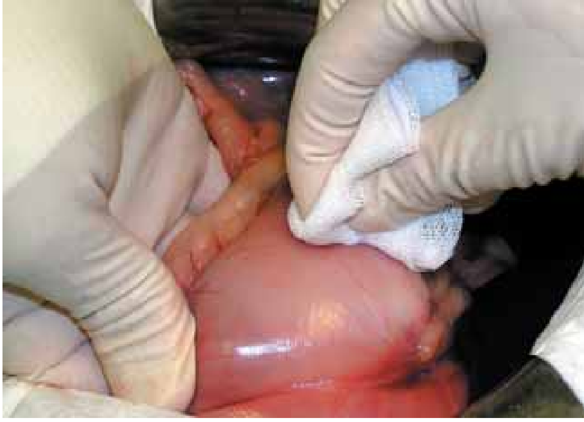


Figure 7. The stomach is cut with Metzenbaum scissors.

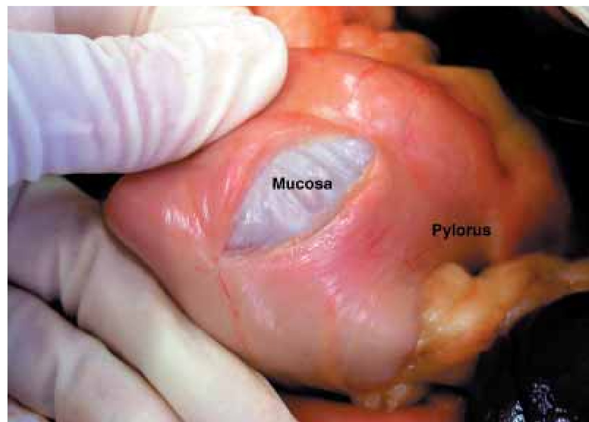


Figure 8. After cutting the stomach mucosa is intact and pulping out from incision.

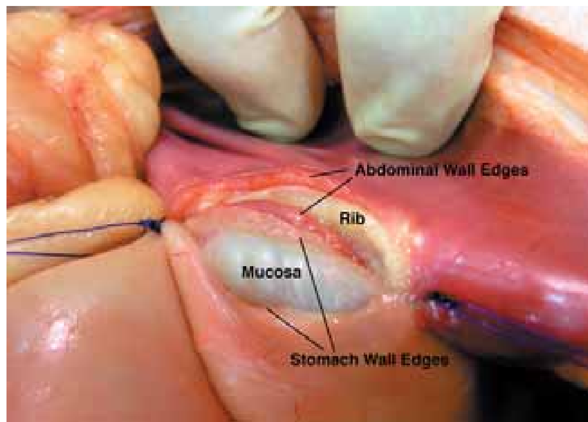


Figure 9. Stay-sutures are knotted and gastropexy wounds, that are about to be sutured, are appositioned.

towel clamps (Fig. 4).

To choose the correct site for the gastric antrum incision, draw an imaginary line from the lesser curvature parallel to the long axis of the dog. The stomach incision site is midway between the pylorus and the imaginary line (Fig. 5). Orient the stomach incision parallel to the long axis of antrum, and midway between lesser and greater curvatures to avoid damage to stomach vasculature. If you are a right-handed surgeon, lift up the stomach body with the left middle finger leaving your thumb and index finger free. Thoroughly wipe and dry your left thumb and index finger with a dry sponge. Carefully wipe the surface of the proposed antral gastropexy site. Pinch about 4 centimetres of the antral site (full-thickness) between the thumb and index finger (held parallel to the long axis of the antrum). Lift the pinched stomach wall until the mucosa distinctly slips out from between the fingers (Fig. 6). What remains grasped after this maneuver is just the serosa and muscular layer of the stomach wall. With Metzenbaum scissors, create a partial thickness gastric antral incision by cutting to the base of the pinched wall towards the tips of the fingers (Fig. 7). Since the gastric mucosa has been squeezed away from the pinched wall, no perforation into the stomach is possible and only the seromuscular layer is incised (Fig. 8). The stomach incision should be 3-4 centimetres in length. If this technique is performed incorrectly and gastric mucosa is perforated inadvertently, close the mucosa with 3-0 absorbable suture material.

Bring the stomach wound in apposition to the rib incision so that the pylorus is pointing in a cranial direction. Fasten stay sutures to both ends of the incisions thorough the seromuscular stomach layer and transverse abdominal muscle. Use 2-0, prolon-

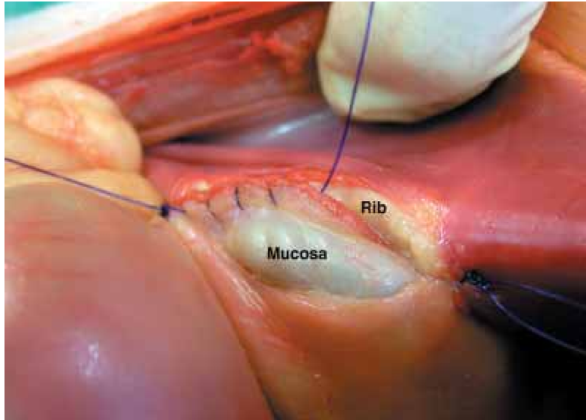


Figure 10. The caudal edge of the stomach wound and the dorsal edge of the abdominal wall is sutured with a simple continuous suture pattern.

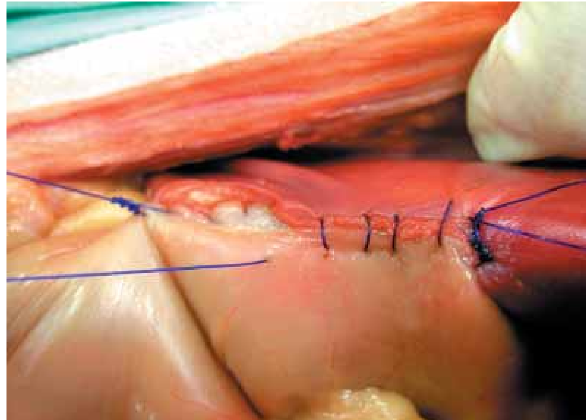


Figure 11. The cranial edge of the stomach wound and the ventral edge of the abdominal wall is sutured similar to the first line.

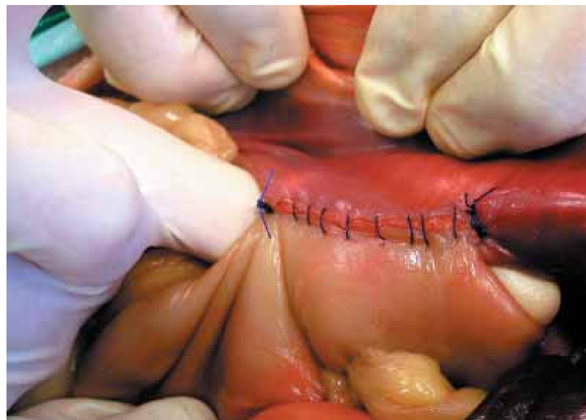


Figure 12. The stomach is attached to the abdominal wall with two continuous lines.

ged absorbable or nonabsorbable monofilament suture material (i.e. polydioxanone) on a taper needle. When stay-sutures are placed and tied, bring the lower stomach and abdominal wall edges in apposition with thumb forceps so the edges are easy to suture (Fig. 9). Leave the needles attached to the stay sutures so that they can be used to appose the incision edges for the gastropexy. With the cranial stay suture needle, begin suturing the caudal edge (greater curvature side) of the incised stomach wall to the dorsal edge of the abdominal wall incision (the two muscle edges between stomach mucosa and rib) with a simple continuous suture pattern (Fig. 10). At least 3-4 mm bites of tissue should be included on either side of the suture line. Avoid entering the stomach lumen with the needle if possible. The first suture line is ended and tied to the knot ears of the stay suture at the other end of the incision. Using the needle from the caudal stay suture, appose the remaining (lesser curvature side) free edge of the stomach incision to the ventral part of the abdominal wall incision with the same suture pattern (Fig. 11). Tie this suture line to the knot ears of the cranial stay suture knot. After both suture lines are completed, both incision edges of the stomach and abdominal wall are firmly apposed (Fig. 12). Close the celiotomy incision in a routine fashion.

CONCLUSIONS

Gastric dilatation volvulus is a common, life-threatening problem in large deep-chested dogs and its reoccurrence is high if a right-sided gastropexy is not performed. Therefore, gastropexy is recommended for every patient with GDV, and also for susceptible patients with a history of gastric dilatation. After stabilization, surgical correction of GDV should be performed without delay because of the higher anesthetic risk of the patient. Every emergency veterinarian in small animal practice faces patients with GDV in need of immediate care. In Finland it is not always possible to refer these critical patients, and the veterinarian is often obligated to perform surgery alone. Consequently, it is important that the gastropexy technique can be performed simply without the aid of an assistant.

This technique, as described, can be easily performed alone. The towel clamps help elevate and stabilize the twelfth rib with one hand so the other can make the muscle incision with one bold stroke. As the rib is held elevated, the abdominal wall incision is created well away from the diaphragm and deeper vascular structures. Because the incision is made directly over the rib, it is safe to make a deep cut to expose raw tissue edges suitable for permanent adhesion formation. The described stomach slip technique allows the solo surgeon the ability to stabilize the stomach and, simultaneously, create a deep stomach incision without risking perforation of the mucosa. The pre-placed stay-sutures keep stomach and abdominal wall layers well apposed so that suturing is easy since there is no tension during needle placement.

This incisional gastropexy technique integrates known gastropexy principles that are documented to result in permanent adhesions between the stomach and abdomen (Fossum 2002, Monnet 2003, Slatter 2003). One of the authors (DS) has been using this successful technique for more than ten years at The Ohio State University, and it has been introduced more recently at the University of Helsinki. Even thought this technique is designed to be simple and rapid, the authors encourage inexperienced surgeons to practice any unfamiliar surgical procedure on cadavers first before attempting to perform the technique on a clinical patient.

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Retropulsion of Urethral Calculi in the Dog

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Colorado State University

If you would like a video of this retropulsion procedure go to **www.videovet.org** or contact videovet@me.com.

INTRODUCTION

Uroliths are defined as calculi lodged in the urethra causing partial or complete obstruction and urethritis. Uroliths may be caused by infection, diet, or they may be metabolic.

Generally, small cystic calculi migrate to the neck of the bladder during micturition and pass into the urethra. In the male, urethral calculi most commonly lodge caudal to the os penis. In the female, calculi may lodge at any location along the length of the urethra. Urethral obstruction is more common in the male than female.

CLINICAL SIGNS

Clinical signs include stranguria, hematuria, pollakiuria, and occasionally blood dripping from the prepuce. Patients with complete urinary obstruction may present with a painful, distended abdomen, anuria, and azotemia. The severity of signs is often dependent upon degree and duration of urethral obstruction.

DIAGNOSIS

Diagnosis is generally based on suspicious clinical signs, inability to pass a catheter into the urinary bladder, and survey radiography or positive contrast retrograde urethro- cystography revealing a urethral obstruction.

DIFFERENTIAL DIAGNOSIS

Diagnostic differentials include neoplasia, urethral stricture, urethritis (e.g., granulomatous), and urethral trauma

TREATMENT

Immediate care is dependant upon patient presentation and severity and duration of urinary obstruction. In animals with complete obstruction of a duration long enough to cause azotemia, temporary urinary diversion is provided by either passing a urinary catheter alongside the calculus, performing a prepubic cystostomy, or frequent cystocenteses. Treatment of azotemia with crystalloid IV therapy is performed prior to calculus removal.

RETROGRADE HYDROPULSION

Technique

This technique should result in a 90-95% success rate of retropulsing urethral calculi into the urinary bladder!

1. Select the largest diameter sterile high density polypropylene or nylon urinary catheter (not a red rubber feeding tube) that will fit past your patients os penis (generally 6, 8, or 10 French diameter)

2. If the selected catheter turns out to be a 6 French diameter then mix 30cc of Sterile KY Jelly with 70cc of sterile physiologic saline solution.

3. If the selected catheter turns out to be an 8 or 10 French diameter then mix 40cc of Sterile KY Jelly with 60cc of sterile physiologic saline solution.

4. Thoroughly mix the sterile saline and KY Jelly in a 35 or 60 cc syringe and attach the syringe to the urinary catheter.

5. Anesthetize the patient, extrude the penis and pass a generously lubricated nylon or polypropylene urinary catheter in the urethra up to and against the calculus. Place a dry gauze sponge around the extruded tip of the penis and occlude the penis around the catheter by squeezing it with thumb and finger.

6. Using a back and forth action on the catheter, simultaneously inject the saline/lubricant mix under extreme pressure. Be certain the catheter tip hits the calculus like a battering ram to help dislodge it and encourage the saline-lubricant mix to surround the calculus and coat the urethral wall. During injection the calculi and urethra are lubricated by the saline/lubricant mix while the viscosity of the mixture (i.e., KY jelly and saline) encourages the calculus to dislodge and become retropulsed into the urinary bladder.

This technique is successful regardless of how many stones are in the urethra and no matter where the calculi are lodged.

If the above technique fails, place a finger in the rectum, palpate the urethra and occlude its lumen (this dialates the urethra); repeat the above maneuvers and when maximum pressure is exerted on the urethra by the saline/lubricant mix (i.e., the urethral is maximally dialated), suddenly release digital urethral occlusion allowing lodged calculi to flush into the urinary bladder.

Urethrotomy (an incision over the calculi) may be performed to remove calculi that cannot be retropulsed. It is usually performed in the prescrotal or perineal region.

Urethrostomy (a permanent opening to allow calculi to pass) may be indicated in animals that are chronic recurrent calculi formers (e.g., urate calculi in Dalmatians). Scrotal urethrostomy is the technique of choice.

PATIENT MONITORING

Patients requiring a cystotomy only can be expected to pass small quantities of blood and blood clots for 2 - 3 days postoperatively. Animals presenting with complete urinary obstruction and postrenal azotemia are continued on crystalloid IV therapy until serum urea nitrogen and creatinine return to normal.

Patients requiring a urethrotomy or urethrostomy may hemorrhage from the urethral stoma and is the most common immediate postsurgical complication. It generally occurs 4 - 5 days postoperatively, but occasionally will last up to 2 weeks. Mild dripping is managed with cage rest and tranquilizers to decrease blood pressure. Moderate hemorrhage is managed by mild pressure with a cold compress placed directly over the urethrostomy site. In some cases it is necessary to apply an Elizabethan collar to prevent self-mutilation.

SPLENECTOMY

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INTRODUCTION

Splenectomy can be a life-saving procedure and is often necessary on an emergency basis. Unfortunately, most dogs that present with a spontaneous hemoabdomen associated with a splenic bleed have neoplasia as the underlying etiology, although benign lesions such as hematomas may also be seen. Stable dogs with non-ruptured splenic masses are also candidates for splenectomy. Spontaneous hemoabdomen is a challenging condition that requires rapid diagnosis with timely therapeutic intervention to maximize the chance of a successful outcome. Unfortunately, malignant neoplasia is the most common etiology and despite a successful short-term outcome, a guarded long-term prognosis is common. The peritoneal cavity can be considered a large potential space in which the majority of a dog's blood volume can reside. Consequently, with rupture of a highly vascular intra-abdominal organ, vascular collapse and end-organ ischemia can result rapidly. The major objectives of the veterinarian who is treating a patient with spontaneous hemoabdomen include rapid and effective resuscitation, timed surgical intervention, rapid identification of the point of hemorrhage and efficient elimination of the source of hemorrhage.

INDICATIONS

Splenectomy is indicated for removal of splenic neoplasm, rupture, torsion, infarct, abscess and hypersplenism.

PATIENT POSITIONING

The patient is placed in dorsal recumbency for routine celiotomy.

RECOMMENDED INSTRUMENTS

A Balfour self-retaining abdominal retractor is essential to maintain adequate exposure allowing complete exploration of the abdominal cavity as well as visualization of the splenic blood supply. When large amounts of blood or fluid are present in the abdominal cavity suction, using a Poole suction tube, is helpful. It is best to have a variety of sizes of hemostats available. The author recommends a minimum of 6 medium to large hemostatic forceps (Crile, Kelly or Carmalt) and 4 – 5 small hemostatic forceps (mosquito).

Ligation of individual blood vessels or clusters of vessels is performed using 2-0 or 3-0 synthetic absorbable suture material. Common sutures include Biosyn, Monocryl, Dexon, Vicryl, Polysorb, PDS or Maxon. A secure friction knot such as a Strangle knot, Double Half Hitch or Modified Miller's knot is recommended for secure vascular ligations.

SURGICAL TECHNIQUE

A ventral midline incision from xyphoid to pubis is made to allow adequate exposure of all abdomen organs. The falciform ligament is removed from its attachment to the body wall and xyphoid and a large (10'') Balfour self-retaining retractor is positioned (with the frame of the Balfour toward the cranial aspect of the incision) to provide exposure of the abdominal cavity.

The spleen is located in the cranial left quadrant of the abdominal cavity just caudal to the greater curvature and fundus of the stomach. The spleen is identified, and gently

elevated through the abdominal incision. If the surgeon is dealing with a bleeding spleen (e.g., hemangiosarcoma) the exteriorized spleen is placed across the body wall to help place pressure (tether) on the splenic blood vessels. In addition, a dry laparotomy pad can be placed directly on the point of hemorrhage and gentle pressure applied. At this point a rapid and complete abdominal exploratory is performed to rule-out obvious metastasis.

Prior to splenectomy several structures should be identified. The greater curvature of the stomach, dorsal and ventral layers of the greater omentum, the gastrosplenic ligament and the left limb of the pancreas. These structures are best visualized by entering the epiploic foramen. To do this elevate the greater omentum from the abdominal cavity. The omentum consists of two ‘leaves’. Pull the two leaves apart and break into the omental foramen. Work your way down to the splenic vasculature and left limb of the pancreas. Trace the splenic artery and vein as they course from the dorsal layer of the greater omentum into the gastrosplenic ligament. Identify the left gastroepiploic artery and vein, the many splenic arterial and venous branches into the hilus of the spleen, the short gastric vessels and the vessels continuing into the greater omentum.

The spleen receives its blood supply from 3 major sources. Three to four short gastric vessels supply the cranial aspect of the spleen. The central portion of the spleen is supplied by the major splenic artery and vein and the caudal pole of the spleen by 4-5 small omental tributaries.

Once the splenic vasculature has been identified the spleen can safely be removed using a technique requiring only 3 to 4 cluster ligations. Visualization of these vessels is accomplished by first elevating the spleen from the abdominal cavity. When attempting to exteriorize the spleen it is noted that its cranial pole is tethered to the greater curvature of the stomach by the 3 to 4 short gastric vessels. These vessels are identified and cluster ligated with two encircling ligatures. The vessels are transected between ligatures thus releasing the tethering effect. The spleen can now be further mobilized from the abdominal cavity allowing easy exposure of all remaining vessels.

Next the major splenic artery and vein is located and ligated prior to its bifurcation. Care should be taken to visualize the left limb of the pancreas and make certain it is a safe distance from the proposed ligation site. The splenic artery and vein are generally double ligated and depending upon size the artery can be transfixed. Finally, the remaining vessels supplying the caudal pole of the spleen are cluster ligated using one or two ligatures.

During the procedure, several points should be remembered:
1) when ligating the splenic artery and vein, identify the location of the pancreas and do not occlude its blood supply
2) double ligate all major vessels
3) carefully inspect all ligated vessels for evidence of hemorrhage

CLOSURE
The Balfour retractor is removed and the abdominal incision is closed in a routine fashion.

POSTOPERATIVE CONSIDERATIONS

Postoperative care involves monitoring the patient for blood loss that may be encountered should a ligature slip from the ligated vessels.