Proudly Presents:

**PRACTICAL TECHNIQUES IN SOFT TISSUE SURGERY**

With:

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DVM, DACVS

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Howard B Seim III, DVM, Diplomate ACVS  
Practical Techniques in Soft Tissue Surgery

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**Generic lecture description:**
Video segments of clinical case material, carefully edited to form a real life experience, are used as a means of delivering the surgical lectures. All video cases are client owned animals and all of the surgical procedures performed are on patients that have come to the instructor’s hospital. Case selection includes practical surgical procedures that many veterinarians are able to perform in their practice. An advantage of this lecture style is that participants are able to see the case actually operated on during the lecture.

**Surgical management of GDV**
This seminar will focus primarily on the surgical management of GDV patients. Video of clinical cases during presentation and intraoperative decision making will be presented. We will focus on the authors’ preferred method for gastric derotation and the technical aspects of performing a 10-minute incisional gastropexy. Extensive use of video of clinical cases will give participants a real life experience.

**Surgical repair of diaphragmatic hernia**
This session will discuss the three most common types of diaphragmatic hernia; acute traumatic, chronic traumatic, and peritoneopericardial. Video of clinical cases will be used to illustrate techniques used to surgically repair each type of hernia. Management of chronic atelectatic lung lobes and the incidence of re-expansion pulmonary edema will be discussed.

**Surgical management of canine cystic calculi**
A ‘never fail’ technique for retropulsion of calculi lodged in the urethra of male dogs will be presented. Surgical management of cystic calculi will be discussed and a new protocol that will eliminate the possibility of leaving a
stone behind after performing a cystotomy to retrieve multiple cystic calculi will be described. Videotape of clinical cases will be used to illustrate all techniques.

**Feline perineal urethrostomy – a novel approach**  
Feline perineal urethrostomy has classically been approached with the patient placed in a perineal position. Although this positioning is awkward for the surgeon it has become the standard approach. This lecture will suggest taking another look at patient positioning. Placing the cat in dorsal recumbancy allows for a much more ‘ergonomic’ approach for the surgeon and enhances visualization of the regional anatomy. Video of this novel approach will be used to illustrate its advantages to the perineal approach.

**Surgical management of brachycephalic syndrome**  
This session will discuss the management of upper airway obstruction in brachycephalic breeds. Emphasis will be placed on nasoplasty technique, soft palate resection, and removal of everted laryngeal saccules. Videotape will be used to illustrate surgical techniques.

**The 4 ligature splenectomy**  
Years ago the anatomist suggested that in order to safely remove the spleen the left gastroepiploic artery and vein must be preserved or the gastric blood supply would be put at risk. We now know this is not true. I will suggest a way to use this new anatomic information to safely remove the spleen in a non-GDV patient with 4 (maybe 5) ligations.

**Anal saccullectomy: a novel approach**  
Anal saccullectomy is frequently performed in veterinary practice. It can be tricky to get all of the anal sac epithelium and preserve the external anal sphincter muscle and caudal rectal nerve. A ‘new’ technique has been developed that facilitates complete removal of the anal sac while encouraging protection of caudal rectal nerve fibers and external anal sphincter muscle. Video tape showing this technique in a clinical case will illustrate its potential usefulness in practice.

**Wound management secrets**  
Think of the most difficult location to bandage a wound......this seminar will suggest a method of how you can ‘bandage that wound’! Can you force a wound to continue to contract?......Oh yes you can! Videotape of these selected ‘secrets’ to facilitate wound management will be discussed.
SURGICAL MANAGEMENT OF GDV

Howard B. Seim III DVM, DACVS
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If you would like a copy of this surgical procedure on DVD 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; not surgery. 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. Decompression via flank needle puncture should be attempted in cases difficult to intubate or severely depressed metabolically deranged patients.

Technique: The stomach tube is measured to the last rib and marked with a piece of tape. A stiff foal or mare stomach tube with a smooth beveled tip works best (having several diameter and stiffness tubes is ideal). Apply adequate 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 generally meet resistance at the esophageal-stomach junction. Pass the tube firmly in a twisting manner to pass 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 rear feet on floor and forefeet on table, right lateral recumbancy, and left lateral recumbancy). This movement may encourage the stomach to rotate enough to allow tube passage. Be careful not to position the patient in dorsal recumbancy as this will increase abdominal visceral pressure on the caudal vena cava and may 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 trocarization site. After trocar decompression, 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, but 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 placed.

**Referral:** If you are successful at passing a stomach tube, but 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 as described below.

**Pharyngostomy 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 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 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:** Surgical procedures utilized in the treatment of gastric dilatation-volvulus can be divided into two categories; 1) immediate decompression and 2) therapeutic gastropexy. Immediate decompression is performed with a successfully passed stomach tube secured to the patient or temporary gastrostomy as described above. Therapeutic or prophylactic gastropexy techniques are described below.

**Gastric repositioning:** Anatomic repositioning of the stomach is necessary to perform prior to permanent gastropexy. Repositioning occasionally occurs spontaneously at the time of gastric decompression. Knowledge of normal anatomy is necessary to understand how repositioning is performed.
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 all of the falciform ligament to the level of the xyphoid.
Place a 10” Balfour self retaining abdominal retractor with full retraction.
Confirm that the omentum is draped over the exposed surface of the stomach (pathognomonic for GDV)
Exteriorize the spleen from the abdominal cavity. Evaluate color, texture, blood flow (splenomegaly is always present and is NOT an indication for splenectomy)
Splenectomy is rarely performed but may be necessary if splenic vessels are infarcted.
If the stomach is full of air or fluid it should be emptied, if possible, prior to attempting derotation. If the stomach is full of food and several attempts to derotate (see author’s technique below) are unsuccessful, perform a gastrotomy and manually remove the food from the stomach lumen. Suture the gastrotomy and attempt derotation again.

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.
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.

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

Commence your gastropexy procedure.

**Incisional gastropexy:** This technique is based on the construction of a seromuscular antral flap attached to a incised segment of transversus abdominus muscle. Prior to selecting the location on the transversus abdominus m for gastropexy, visualize the diaphragmatic muscle fibers as they radiate into the abdominal cavity and attach near the costal arch. It is important that the gastropexy site be distant from the diaphragm muscle insertion. In addition, it is important to locate the ideal position for the gastric antral incision. The incision is located equidistant between the pylorus and gastric incisure and equidistant between the greater curvature and lesser curvature. A 3-4 cm incision is made in the antral portion of the stomach. Once the antral incision has been made, the bleeding surface of the antrum 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 2-3 cm deep to the abdominal wall incision and 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 stomach 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. Occurrence of a total body potassium deficit has been proposed. Etiology of the hypokalemia includes anorexia, vomiting, tremendous outpouring of potassium rich fluids into a dilated stomach, and use of potassium poor fluids in treatment of shock. For this reason, adding 20-30 mEq of potassium chloride per liter of maintenance fluids during and after surgery are recommended.
g. Gastric motility: occasionally GDV patients will develop postoperative gastric motility abnormalities. Patients with gastric hypomotility or gastric stasis should be treated with a motility modifier (i.e., metaclopramide, erythromycin, etc).
DIAPHRAGMATIC HERNIA REPAIR

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If you would like a copy of the video of this surgical procedure on DVD, go to www.videovet.org.

Key Points
- Most diaphragmatic hernias are not acutely life threatening
- Suture the hernial rent from dorsal to ventral
- Use a one layer simple continuous appositional suture pattern for closure
- Evacuate all thoracic air prior to closure

General Considerations and Indications
Three classifications of diaphragmatic hernia may be diagnosed; acute traumatic, chronic traumatic and congenital diaphragmatic hernia.

Acute Traumatic
This is the most common type of diaphragmatic hernia in dogs and cats. It is generally caused by vehicular trauma but can be caused by any form of trauma.

Chronic Traumatic
This classification of diaphragmatic hernia is seen when a patient has an acute traumatic hernia that was undiagnosed at the time of occurrence. Later (months to years) the hernia is diagnosed due to sudden or chronic onset of respiratory difficulty.

Congenital
The most common congenital hernia involving the diaphragm is a peritoneal-pericardial diaphragmatic hernia. Whenever this defect is suspected, a thorough examination (i.e., physical, radiographic, cardiovascular) for evidence of further midline congenital defects (i.e., umbilical hernia, atrial and ventricular septal defects, cleft palate) should be performed.

Applied Anatomy
The diaphragm projects into the thoracic cavity like a dome; it attaches to the lumbar vertebrae, costal arch, and sternum. Fibers arise on these skeletal parts and radiate towards the tendinous center. The diaphragm is composed of only one layer of muscle and two layers of tendon and therefore is weaker than the multilayered abdominal wall. The central tendon of the diaphragm of the cat is relatively small. In its tendinous portion, transverse fibers course from one side to the other as a reinforcing apparatus.

The muscular part is divided into the pars lumbalis, a pars costalis on each side, and the pars sternalis, all of which with the exception of the lumbar portion, have a uniform thickness of 2-3 mm in cats. The pars lumbalis of the diaphragmatic musculature is formed by the right and left diaphragmatic crura, the right crus being considerably larger than the left. Seen from the abdominal cavity each crus of the diaphragm is a triangular muscular plate whose borders give rise to the tendinous portions. The pars costalis on each side consists of fibers radiating from the costal wall to the tendinous center. The pars sternalis is an unpaired medial part unseparated from the bilateral costal portions.
The diaphragm domes far into the thoracic cavity, and its costal part lies on the medial surface of the last few ribs and costal arch (when tears occur here, the costal arch can be used in the repair). The stomach and liver attach by ligaments to the concave peritoneal surface of the diaphragm.

**Diagnosis**

Diaphragmatic hernia is generally diagnosed via thoracic and abdominal radiographs. Classic findings on thoracic radiographs is loss of the diaphragmatic line, air filled visceral structures in the thoracic cavity, loss of lung fields. Abdominal radiographs may reveal a lack of abdominal viscera. Classic thoracic radiographs of a patient with a peritoneo-pericardial diaphragmatic hernia shows a large, round pericardial sac. Occasionally, air filled viscera can be identified in the pericardial sac. Patients that present with an acute traumatic diaphragmatic hernia (e.g., hit by a car) may have a massive hernia with abdominal contents replacing most of the patients respiratory capacity.

**Preoperative Considerations**

Immediate surgical intervention for the repair of a diaphragmatic hernia is rarely indicated. Emergency surgery should not be undertaken unless the surgeon and anesthesiologist are prepared to handle any complications and are confident they can maintain the animal's essential requirements while the animal is anesthetized. However, prompt surgical repair is indicated in acutely injured animals with severe dyspnea, cyanosis, and respiratory distress who demonstrate massive herniation, and in patients that present with an air filled stomach in the thoracic cavity (these patients can develop life threatening dyspnea if enough swallowed air enters the stomach).

The most commonly encountered patient with diaphragmatic hernia will fall between the two categories mentioned above and should be handled in a systematic manner that will not further compromise the patients already reduced breathing ability. Surgery is not considered an emergency in mildly symptomatic or asymptomatic animals with congenital hernias or traumatic hernias of at least several days' duration. Remember that any stressed, dyspneic cat should be handled very carefully as further stress can produce catastrophic results.

**Anesthesia**

Patient stress must be kept to a minimum during the anesthetic induction phase as any exertion by the animal can be disastrous.

**Surgical Approaches**

A midline abdominal celiotomy (xiphoid to pubis) is the easiest and most versatile approach. Positioning the patient's head toward the top of the table and tilting the table at a 30° to 40° angle will facilitate gravitation of abdominal viscera out of the thorax. Rarely is it necessary to extend the incision into the thorax via a median sternotomy however the animal should be prepared in case this becomes necessary.

**Surgical Procedure**

See the DVD for a detailed video description of this technique. When an extra pair of hands is unavailable for retraction, a Balfour self retaining retractor is a helpful piece of equipment; large Gelpi retractors work well in cats. Using the abdominal approach, an incision is made from xiphoid to pubis. Once the peritoneal cavity is opened, the diaphragm is exposed and the situation evaluated. Some hernias, especially in the area of the dorsal attachments of the crura and the aortic hiatus are not easily visualized; therefore, this area should be carefully inspected even when another laceration is present. The herniated contents are replaced in their proper position and inspected for damage.
Using large sponges or laparotomy pads moistened with warm saline, the liver and bowel are retracted caudally. Visualization of the cranial quadrant of the abdomen can be facilitated by removing the viscera from the abdominal cavity and placing it on a moistened laparotomy sponge. The diaphragmatic tear is now more easily visualized so that a careful examination of the thorax can be done both visually and manually. All thoracic fluid should be aspirated.

In acute traumatic diaphragmatic hernia, the lungs should be expanded to remove atelectasis and to inspect for pulmonary tears and persistent areas of collapse.

In chronic traumatic hernias care is taken not to inflate the lungs. When lung parenchyma is atelectatic for such a long period of time the alveoli collapse. If they are suddenly expanded with air the tight junctions of the normal alveoli are damaged and the infated alveolus fills with fluid. This is referred to as re-expansion pulmonary edema. This is a life threatening disorder and should be avoided.

It is recommended to suture the hernia from dorsal to ventral thus making it much easier to visualize the dorsal structures (vena cava, aorta, esophagus) when suturing. The hernia is closed with a single layer, simple continuous suture pattern using synthetic absorbable suture material (Dexon, Vicryl, Biosyn PDS, Maxon) or monofilament nonabsorbable suture material (Nylon, Prolene, Novafil). Suture size recommended in cats is 3-0. It might be necessary to preplace the most dorsal sutures for better visualization of the tear during suturing. It is also helpful to reconstruct the tear with several simple interrupted sutures to facilitate visualization of the rent. When tears near the caval hiatus are sutured, care is taken to avoid constriction of the vena cava by placing sutures to close from the cava. The same principle applies to the aortic and esophageal hiati.

Air can be evacuated from the chest using several techniques.

1. Prior to tying the last knot of the hernial closure, a carmalt forceps is placed in the hernial rent between two sutures and gently spread open to allow access to the thoracic cavity. The lungs are inflated so as to fill the thoracic cavity. The carmallts are removed and the last suture tied to provide an air tight and water tight seal.

2. After hernial rent closure a needle or plastic intravenous catheter is placed through the diaphragm and into the thoracic cavity. Thoracic cavity air is evacuated using a syringe.

3. Needle thoracentesis is performed after the procedure is complete.

4. A 12 - 14 French feeding tube is brought into the peritoneal cavity through a paramedian stab incision in the cranioventral body wall. The tube is passed through the diaphragmatic rent between to sutures just prior to its final closure. Make certain that all fenestrations in the tube are beyond the diaphragm. The diaphragmatic rent closure is then completed around the tube. With the use of a 3-way stop cock and 60 cc syringe, air is evacuated from the thorax until a gentle negative pressure is obtained. The celiotomy incision is closed in a routine fashion. When the celiotomy closure is complete, the tube is again aspirated. The patient should then be placed through a series of positional changes (ventral recumbency, right lateral recumbency, left lateral recumbency, and dorsal recumbency) while attempting to aspirate air. When negative pressure is obtained in all positions, the tube is gently pulled from the chest and abdominal incision.

5. A 12 -14 French diameter thoracostomy tube can be placed at the level of the 10th or 11th intercostal space, tunneled to the level of the 7th or 8th intercostal space and placed through the intercostal muscle and into the thoracic cavity. The patient is then placed through a series of positional changes (ventral recumbency, right lateral recumbency, left lateral recumbency, and dorsal recumbency) while attempting to aspirate air. The tube is removed when the patient has had a negative pressure for 12 - 24 hours.
All patients are monitored carefully for the next six to eight hours. If signs of respiratory abnormalities arise (dyspnea, tachypnea, etc), the right and left hemithorax should be tapped with a needle and syringe.

**Postoperative Care**

Postsurgical care includes systemic antibiotics and careful monitoring of the patient's breathing, temperature, and color. Cats should be kept on a warming device for at least 24 hours. Analgesics may be used to relieve patient discomfort, however care should be taken to monitor the effects of various analgesic drugs on respiratory effort. Thoracic radiographs may be taken to evaluate the chest drain and pleural space.

**Summary**

Successful repair of a diaphragmatic hernia depends on careful preoperative and postoperative care of the patient. During the surgical repair, the surgeon must work quickly and effectively to complete the procedure as efficiently as possible.
SURGICAL MANAGEMENT OF CANINE CALCULI

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If you would like a copy of the illustrated version of these notes on CD and a video of this surgical procedure on DVD go to www.videovet.org.

Key Points
- Patients with urethral calculi present with stranguria
- Retropulsion of urethral calculi into the urinary bladder simplifies management of urethral calculi
- Aggressive lavage of the urethra and bladder should be performed during cystotomy
- Permanent urethrostomy is an acceptable method of managing chronic stone formers

Definition: Cystic and urethral calculi have various compositions (i.e., oxalate, struvite, urate, uric acid, cystine, silicate) and may be present in the urinary bladder or lodged in the urethra, respectively. They may be multiple or single, may cause partial or complete obstruction (i.e., urethral), and may require surgical manipulation for removal.

Synonyms: Bladder stones, urethral stones

Diagnosis
Clinical presentation:

Signalment: There is no age predisposition. Dalmations are more likely to present with uric acid calculi and commonly present with calculi lodged in the urethra. Schnauzers are more likely to present with struvite calculi and Daschunds are more likely to present with cystine stones.

History: Patients generally present with a history of urinary obstruction and/or signs of urinary tract infection. Common complaints include difficulty urinating, straining to urinate, hematuria, dripping blood tinged urine from the prepuce, and/or a distended abdomen. Patients that present several days after complete obstruction may have a distended and painful abdomen and a history of anuria. These patients may be so compromised that they present in shock.

Clinical signs: The most frequently reported clinical signs in patients with cystic and urethral calculi include unproductive straining to urinate, blood tinged urine dripping from the prepuce, hematuria, and/or polakiuria. Severity of clinical signs may vary with the degree of urethral obstruction and duration of obstruction prior to presentation. Patients with complete obstruction for several days may show signs of post-renal azotemia (i.e., severe depression, recumbant, shocky).

Physical examination: Observation in the examination room may reveal multiple unsuccessful attempts to urinate. Abdominal palpation may reveal a full urinary bladder; occasionally, calculi within the bladder may be palpable.

Patients with severe clinical signs (i.e., presented several days after complete obstruction) may show azotemia, shock, and/or severe depression. Abdominal palpation generally reveals a large, turgid urinary bladder and may result in discomfort to the patient.

Laboratory findings: Results of a complete blood count and serum chemistry profile are generally normal in patients presenting acutely; urinalysis may show evidence of urinary tract infection and and/or crystaluria.
Patients presenting after several days of complete obstruction may have significant changes in their biochemical profile including increased BUN, increased creatine, metabolic acidosis, and severe electrolyte abnormalities. Urine is generally grossly hemorrhagic and urinalysis may show signs of urinary tract infection and crystaluria.

**Radiography:** Survey radiographs may show presence of radiodense calculi in the urethra and/or urinary bladder as well as a distended urinary bladder. Occasionally, radiolucent calculi occur and can only be visualized using retrograde contrast cystourethrography. The most common location of urethral calculi in male dogs is immediately caudal to the os penis. Careful evaluation of the kidneys and ureters should be done to rule out renal and ureteral calculi.

**Ultrasound:** Ultrasonographic examination of the bladder, ureters, and kidneys may be helpful in diagnosis of cystic, ureteral, or renal calculi.

**Differential diagnosis:** Any disorder causing urinary obstruction, including urethral neoplasia, granulomatous urethritis, urethral stricture, and urethral trauma. Definitive diagnosis is based on clinical signs, inability to pass a catheter, and evidence of calculi on survey or contrast radiographs.

**Medical management:** Immediate care: In animals with complete obstruction of a duration long enough to cause azotemia, temporary urinary diversion is provided by either passing a small urinary catheter (e.g., 5 French) alongside the calculus, performing a prepubic cystostomy (see technique described below), or frequent cystocentesis (i.e., tid to qid). Azotemia is treated with crystalloid IV therapy prior to calculus removal.

**Retrograde hydropulsion:** See the DVD for a detailed video of this technique. This technique should result in a 90-95% success rate of retropulsing urethral calculi into the urinary bladder!

**Technique**
1. Select the largest diameter sterile high density polypropylene urinary catheter 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 animal, extrude the penis and pass the lubricated 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 dilates 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 dilated), suddenly release digital urethral occlusion allowing lodged calculi to flush into the urinary bladder.

**Surgical treatment:** The objective of surgical treatment is to remove all retropulsed calculi from the urinary bladder and any remaining urethral calculi that were unable to be retropulsed. Bladder calculi are removed via cystotomy, urethral calculi are removed via urethrotomy, and patients that are frequent stone formers may benefit form a permanent urethrostomy to allow continual passage of small urethral calculi.

**Preoperative management:** Patients that present acutely can be anesthetized immediately and retropulsion attempted (see above described technique). If urinary tract infection is suspected, preoperative treatment with antibiotics may be instituted.

Patients that present after several days of complete obstruction should be treated medically until the azotemia resolves, blood gas abnormalities resolve, and electrolytes return to normal. The patients electrocardiogram should be monitored if hyperkalemia is present preoperatively. Medical treatment may consist of intravenous fluids, systemic antibiotics, continuous ECG monitoring, and bladder decompression. Bladder decompression may be accomplished via passing a small gauge urinary catheter (e.g., 5 French) past the calculus, multiple cystocentesis (i.e., tid or qid), or placement of an antepubic cystostomy tube (described in detail below).

**Anesthesia:** Routine general anesthesia is performed in patients that present acutely without signs of azotemia.

Azotemic, shocky patients with moderate to severe biochemical abnormalities should be treated as described above until these abnormalities return to normal.

**Surgical anatomy:** The male canine penile urethra consists of urethral mucosa (i.e., urothelium) surrounded by corpus cavernosum urethra, which is in turn surrounded by tunica albuginea. Because of the fluid filled corpus cavernosum urethra (blood) and the tough fibrous connective tissue tunica albuginea, the urethra can withstand tremendous pressure (e.g., as with aggressive retropulsion) without the fear of urethral rupture.

The urinary bladder consists of the following layers; serosa, muscular, submucosa and mucosa. The bladder is lined with transitional epithelium.

**Positioning:** Patients are positioned in dorsal recumbancy for retropulsion, urethrotomy, urethrostomy, cystostomy tube placement and cystotomy.

**Surgical technique:** The surgical techniques vary depending upon the procedure chosen, and are described in detail below:

**Retropulsion:** The technique for retropulsion of urethral calculi is described above in medical management.
Percutaneous cystostomy tube placement: Occasionally, it may be necessary to perform a percutaneous antepubic cystostomy to decompress the urinary bladder whilst treating a severely azotemic patient until they become a better anesthetic and surgical risk.

The patient is sedated and placed in dorsal recumbancy. A 3-4cm incision is centered between the umbilicus and pubis. Subcutaneous tissues are dissected to expose the ventral midline (i.e., linea alba). A 2-3cm incision is made in the linea alba and the bladder wall located. A 12–14 French Foley catheter is advanced through a skin incision 2-3 cm lateral to the abdominal incision, tunneled in the subcutaneous tissue and brought into the abdominal cavity at a location just lateral to the midline abdominal incision. A pursestring suture is placed in the bladder wall at the proposed site of Foley catheter placement with 3-0 monofilament absorbable suture. A 1cm incision is made into the bladder lumen and the Foley catheter advanced. The pursestring suture is carefully tightened to create a water-tight seal, but not to tight as to create bladder wall necrosis. The bladder wall is pexied to the abdominal wall at the point of entry of the Foley catheter with 3-0 monofilament absorbable suture in a simple interrupted pattern. The abdominal wall is closed in a routine fashion. and

The cystostomy catheter is held in place with a Chinese finger trap friction suture technique using #1 monofilament nonabsorbable suture and attached to a closed collection system to avoid urinary tract infection. The cystostomy tube remains in place until the patient is ready for definitive surgical treatment.

Urethrotomy: See DVD for detailed video of this technique.
The urethral calculus to be removed is located by evaluation of radiographs, palpation of the os penis and its relationship to the calculus, and/or passing a catheter in the urethra until it contacts the stone, removing the catheter and using it as a measure to locate the calculus.

A 2–3 cm skin incision is made directly over the calculus. Subcutaneous tissues are dissected until the retractor penis muscle is exposed. The cream colored retractor penis muscle (smooth muscle) is dissected off the corpus cavernosum penis (the corpus cavernosum penis has a bluish tint from venous blood) and retracted laterally. A sharpe #15 BP scalpel blade is used to incise the urethra directly over the calculus being careful to incise the urethra directly on its midline to help decrease cavernous sinus bleeding. No attempt is made to control cavernous sinus hemorrhage with cautery or hemostats as this creates excessive urethral trauma and is generally unsuccessful at controlling hemorrhage. Rather, hemorrhage is controlled via digital pressure and suction until suturing can commence. The calculus is grasped with forceps and removed from the urethra.

The urethral incision can be left open to heal by second intention; if this method is chosen moderate to severe hemorrhage can be expected for several days postoperatively.

Alternately, the urethral incision can be closed using 5-0 multifilament or monofilament absorbable suture in a simple interrupted or continuous pattern. Subcutaneous tissues are closed with 3-0 monofilament absorbable suture in a simple continuous pattern and skin with 3-0 or 4-0 nonabsorbable monofilament suture. If this method is preferred by the author over healing by second intention as postoperative hemorrhage is significantly reduced.

Both urethrotomy techniques (i.e., sutureless or sutured) result in predictable urethral healing without evidence of urethral stenosis or stricture.

Urethrostomy: See DVD for detailed video of this technique.
Urethrostomy is generally performed in patients that are recurrent stone formers. It provides a permanent opening caudal to the os penis that is large enough to accommodate passage of most urethral calculi. This technique is often performed in Dalmations for treatment of recurrent uric acid calculi.

Scrotal urethrostomy is the location of choice for urethrostomy in dogs. It is a convenient location for surgical manipulation, this area of the urethra generally bleeds the least, the urethral diameter will accommodate passage of most urethral calculi, and there is less urine scald postoperatively. Other locations for urethrostomy include prescrotal and perineal.

Prior to surgery a urethral catheter (the largest size that will fit past the os penis) is passed, if possible. After a routine castration and scrotal ablation have been performed, the subcutaneous tissues are dissected to expose the retractor penis muscle. The retractor penis muscle is smooth muscle and appears light grey to cream colored. The retractor penis muscle is dissected from its attachment to the corpus cavernosum urethra. The blood filled cavernous tissue gives the urethra a bluish color. The urethral catheter is palpated and used as a firm surface to cut against when incising the urethra. Every attempt is made to incise the urethra exactly on the midline to help decrease hemorrhage. A 3–4 cm incision is made in the urethra. The caudal aspect of the urethral incision is positioned directly over the ishial arch. As this is the new point of urine flow it is most efficient to have urine exit before it makes a sharp turn ventrally. No attempt is made to control cavernous tissue hemorrhage with cautery or hemostatic forceps; only pressure, suction, and suture pressure should be used.

After incision of the urethra, the glistening urethral mucosa is identified, 4-0 or 5-0 nonabsorbable monofilament suture with a swaged on cutting or taper-cut needle is recommended by the author to suture urethral mucosa to skin. The first urethrostomy suture is placed at the midpoint of either side of the urethral incision to include urethral mucosa, tunica albuginea, and skin (suture split thickness of skin). The suture is tied leaving the end without the needle 3-4 cm long to act as a stay suture. The second suture is placed directly across from the first suture and tied as described for the first. The urinary catheter can now be removed. After the first two sutures are placed, the needle end of one suture is used to begin suturing the cranial portion of the urethrostomy using a simple continuous suture pattern. When the opposite suture is encountered, the stay suture is used to tie off the first continuous suture line. The opposite suture is then used to suture the caudal portion of the urethrostomy in a similar fashion tying the final suture to the remaining stay suture. Fine ophthalmic instruments make tissue handling and suturing easier. Use of a magnifying loupe (about 2x) and head lamp light source enhances visualization of the urethral mucosa and facilitates accurate suturing. It is critical that the surgeon recognize glistening urethral mucosa and suture it to skin. This will decrease (or eliminate) the chance of urethral stricture. It has been shown that a continuous suture pattern incorporating the urethral mucosa and tunica albuginea (i.e., squeezes the cavernous tissue) results in less postoperative hemorrhage.

Cystotomy: See DVD for detailed video of this technique.

After successful retropulsion of urethral calculi into the bladder, the catheter used to retropulse calculi is passed into the urethra and bladder and left in place. A portion of the catheter can be left exiting the penis. Leaving a catheter indwelled in the urethra ensures that remaining cystic calculi will not roll back into the urethra during patient transfer to the surgery suite and during patient prep.

Just prior to aseptic preparation of the abdomen a soft, 10-12 French red rubber catheter or feeding tube is placed into the prepuce and a prepuccal lavage is performed with 180cc of a 1:50 dilution of saline and 1% betadine solution. This aseptically prepares the penis and prepuce so they can remain in the surgical field.
throughout the cystotomy procedure. In female patients the vulva and vaginal vault are similarly aseptically prepared.

A paraperpucial incision is made from just caudal to the umbilicus to pubis. The prepuce is retracted and a midline celiotomy is performed. The bladder is exteriorized and examined. Stay sutures of 3-0 suture are placed in the apex and neck of the bladder. A scalpel blade is used to penetrate the ventral aspect of the bladder and enter the lumen. The ventral cystotomy incision is extended with metzenbaum scissors. The bladder should be opened from apex to neck to allow proper visualization of bladder mucosa and calculi. Stay sutures are placed on each side of the incision at its midpoint to facilitate visualization of the bladder interior. Large hemostats are placed on the stay sutures to help retract the bladder margins to maintain visualization of the bladder interior. A cystotomy spoon is used to scoop the bladder neck for calculi. This is performed several times. When no more calculi can be removed with the spoon, digital palpation of the bladder neck is performed to identify presence of further calculi. If further calculi are palpated further attempts are made to retrieve the calculi. Once no more calculi can be spooned or palpated the previously placed indwelling urethral catheter is removed.

Next, the largest urinary catheter or feeding tube that can be passed through the os penis is passed in the penile urethra to the level of the os penis (i.e., retrograde). A dry sponge is used to grasp the extruded penis to create a water tight seal around the catheter. A 60cc syringe filled with sterile saline is injected through the catheter under moderate pressure. The stay sutures on the bladder incision are retracted to enable visualization of the bladder lumen during lavage. Suction or intermittent spooning is performed during lavage in an attempt to identify and remove any remaining stones. After several lavages and negative results in obtaining stones, the catheter is placed from the bladder to the bladder neck and pelvic urethra (i.e., normograde). Lavage is once again performed in an attempt to identify and remove any remaining stones. After several lavages and negative results the catheter is advanced until it can be seen coming out of the penile urethra. The catheter is run back and forth in the urethra several times to ensure that there are no remaining calculi (i.e., gritty feeling while passing the catheter).

Finally, a piece of bladder mucosa is excised from the cut edge of the cystotomy incision for culture and susceptibility testing. The interior of the bladder is examined for urachal diverticulum, masses, etc. and biopsied as necessary. The bladder wall is closed with 3-0 or 4-0 absorbable monofilament suture material using a swaged on taper or taper-cut needle in a simple continuous or simple interrupted appositional suture pattern. Only one layer closure is necessary. Abdominal closure is routine.

**Suture material/special instruments:**
Urinary catheters of various sizes, Foley catheter, head lamp light source, 2X loupes, ophthalmic instruments, 4-0 and 5-0 monofilament absorbable suture material.

**Postoperative care and assessment:**
Postoperative care varies depending upon procedure performed:

**Percutaneous cystostomy tube:** It is important to keep the percutaneous cystostomy tube attached to a closed collection device. The tube can be connected to a sterile collection bag via a sterile intravenous catheter connection set. An elizabethan collar may be necessary in some patients to prevent iatrogenic removal of the cystostomy catheter. Careful management is important to control catheter related urinary tract infection.

**Sutureless Urethrotomy:** If urethrotomy without suturing is performed, patients must be monitored for blood loss from the urethrotomy site. Blood loss can be severe enough to lower the PCV by 2 – 3%. An Elizabethan
collar may be necessary in some patients to prevent self-mutilation. Patients should be kept quiet and away from other animals (especially bitches in heat!). Tranquilization is occasionally necessary to control hyperactive or overly excitable patients. Clients should be warned that drops of blood may be present from the urethrotomy site as long as 2 weeks postoperatively.

**Sutured Urethrotomy:** If a sutured urethrotomy is performed, patients will exhibit very little blood loss. However, an Elizabethan collar should be considered, especially in patients that may be prone to self-mutilation. Patients should be kept quiet and away from other animals (especially bitches in heat!). Tranquilization is occasionally necessary to control hyperactive or overly excitable patients.

**Scrotal Urethrostomy:** The most common postoperative complication of scrotal urethrostomy is bleeding from the urethrostomy site. Utilization of a simple continuous suture pattern incorporating the urethral mucosa and tunica albuginea (i.e., squeezing the cavernous tissue and creating a air-tight/water-tight seal) has significantly decreased the incidence of postoperative hemorrhage in the authors opinion. An Elizabethan collar should be considered, especially in patients that may be prone to self-mutilation. Patients should be kept quiet and away from other animals (especially bitches in heat!). Over excitement immediately postoperatively can result in frank hemorrhage or subcutaneous hemorrhage. Tranquilization is occasionally necessary to control hyperactive or overly excitable patients.

**Cystotomy:** An indwelling urethral catheter is not recommended after an uncomplicated cystotomy for removal of cystic calculi. An Elizabethan collar should be considered, especially in patients that may be prone to self-mutilation. Patients should be kept quiet and away from other animals.

**Prognosis:** The prognosis for surgical management of urethral and cystic calculi is dependant upon preoperative management of azotemic patients prior to anesthesia, success of retropulsion of urethral stones into the urinary bladder, care in removing all stones via cystotomy, and care of ensuring urethral mucosa to skin apposition during urethrostomy.

Patients that have successful retropulsion of urethral calculi and do not require urethotomy or urethrostomy have a excellent prognosis. If careful attention is paid during cystotomy to ensure that no calculi are left behind (see discussion on cystotomy technique), the prognosis for cure is excellent. Long term prognosis is dependant on evaluaion of calculus composition, dietary management, management of urinary tract infection, and attention to urine pH.

Patients that require sutured or sutureless urethrotomy have a favorable prognosis if all of the remaining calculi are removed from the urinary bladder via cystotomy to ensure that no calculi are left behind (see discussion on cystotomy technique). Attention must be paid to careful lavage during cystotomy to ensure removal of all cystic calculi.

Patients that have an elective urethrostomy have a favorable prognosis if attention is paid to proper surgical technique (i.e., urethral mucosa is sutured to skin). Occasionally, chronic stone forming patients will form a calculus that is to large to pass through the urethrostomy stoma.
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.

If you would like a video of these surgical procedures on DVD go to www.videovet.org or contact the author at videovet@me.com. You may click on the ‘Seminar Price’ for any DVD you would like to purchase.

Definition: Brachycephalic syndrome is a combination of upper airway disorders commonly seen in brachycephalic breeds (e.g., English bulldogs, Boston terriers, 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 above listed disorders.

Diagnosis
Clinical presentation:
  
  Signalment: Brachycephalic breeds are most commonly affected (i.e., English bulldog, French bulldog, Boston terrier, Pug, Pekingese, Boxer, and Bull Mastiff). 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, antiinflammatory 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 steroids (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 to 10 minutes prior to induction. A vagolytic agent (i.e., atropine) should be considered 10 to 15 minutes prior to induction because vagal tone is generally increased and cardioinhibitory 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 DVD available via www.videovet.org.

Stenosis is decreased by removing a horizontal wedge of alar cartilage 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 DVD available via www.videovet.org.

The patient is placed in ventral or dorsal recumbancy with the mouth opened widely (see positioning). A broad malleable retractor is used to retract the tongue caudally; this greatly facilitates visualization of the soft palate and laryngeal structures. A headlamp 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. The soft palate is evaluated for extent of resection. A Babcock or Allis tissue forceps is used to grasp the caudal
margin of the soft palate. The length of the soft palate in relation to the tonsil and epiglottis is examined. The soft palate should extend no further caudal than the midpoint of the tonsil. Alternately, the incision is made at the point where the soft palate just slightly overlaps the tip of the epiglottis.

Once this line of excision is determined, a 3-0 or 4-0 Dexon, Polysorb or Vicryl stay suture is placed in the soft palate on each lateral margin of the proposed excision. A third stay suture is placed on the margin of the central portion of the soft palate. The incision is begun from the left or right margin and one-third to one-half of the soft palate is incised.

Using the long end of one of the 3-0 or 4-0 Dexon, Polysorb or Vicryl stay sutures, the incised nasal mucosa is sutured to the incised oral mucosa using a simple continuous suture pattern. Dexon, Polysorb or Vicryl is chosen because of its soft supple nature; Maxon, Biosyn or PDS are much too stiff and may cause irritation to the oral cavity. Hemorrhage is controlled by suture pressure. No attempt is made to cauterize or clamp bleeding vessels. 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.

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.

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.

Suture material/special instruments:
Malleable retractors, head lamp, long-handled laryngeal cup biopsy forceps (or similar instrument), long-handled Allis tissue forceps, long-handled scalpel handle, long-handled rat tooth 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 hrs 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.

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. Patients requiring a tracheostomy prior to surgery, or an emergency tracheostomy, remain in a critical care environment until the tracheostomy can be removed.

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

**Stenotic nares only:** About 96% of dogs with stenotic nares will improve postoperatively.

**Soft palate resection only:** 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%).

**Stenotic nares and soft palate resection:** 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%).

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

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**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 is helpful. It is best to have a variety of sizes of hemostats available. The author recommends a minimum of 4 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 3-0 or 4-0 synthetic absorbable suture material. Common sutures include Biosyn, Monocryl, Dexon, Vicryl, Polysorb, PDS or Maxon.

**SURGICAL TECHNIQUE**
A ventral midline incision from xyphoid to pubis is made to allow adequate exposure of all abdomen organs. The spleen is located in the cranial left quadrant of the abdominal cavity just caudal to the greater curvature and fundus of the stomach. A Balfour self-retaining retractor is positioned to provide exposure of the abdominal cavity.

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 on the splenic blood vessels. In addition, a dry laparotomy pad can be placed directly on the point of hemorrhage and gentle pressure applied.

Several structures should be identified. The greater curvature of the stomach, dorsal and ventral layers of the greater omentum, the gastroplenic ligament and the left limb of the pancreas. Trace the splenic artery and vein as they course from the dorsal layer of the greater omentum into the gastroplenic 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 five 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.

The spleen can safely be removed using a technique requiring only 3 to 4 ligatures. 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 the cranial pole is tethered 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 ligature site. This 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) 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.
ANAL SACCULECTOMY; A NOVEL APPROACH

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Key Points

• knowledge of anorectal anatomy and neuroanatomy is important to the surgeon
• remove all anal sac epithelium during anal sacculectomy
• use of a Foley catheter may facilitate anal sacculectomy

If you would like a video of this surgical procedure on DVD go to wwwvideovetorg or contact videovet@me.com. You may click on the ‘Seminar Price’ for any DVD you would like to purchase.

Introduction: Disorders involving the anus and rectum occur frequently in small animal practice. In order to appropriately diagnose and treat these disorders, knowledge of the regional anatomy, physiology, common clinical signs they produce, and proper physical examination techniques are necessary.

Anatomy: The location and function of the following anatomic structures should be reviewed prior to surgical management of diseases of the anus and rectum: internal and external anal sphincter muscle, anal sac and duct, circumanal glands, caudal rectal artery, vein and nerve, and columnar zone of the anus. These structures are commonly involved in many of the disease processes discussed below and their preservation or removal plays an important part in the patient’s ultimate recovery.

The Anal Sphincter Muscle (From the introduction of a report on hemorrhoidectomy written by WC Bornemeier and published in Am J of Proc, Feb, 1960.): "The prime objective of a hemorrhoidectomy is to remove the offending varicosity with as little damage as possible to the patient. Of all the structures in the area, one stands out as the king. You can damage, deform, ruin, remove, abuse, amputate, maim, or mutilate every structure in and around the anus except one. That structure is the sphincter ani. There is not a muscle or structure in the body that has a more keenly developed sense of alertness and ability to accommodate itself to varying situations. It is like the goalie in hockey...always alert."

"They say man has succeeded where the animals fail because of the clever use of his hands yet, when compared to the hands, the sphincter ani is far superior. If you place into your cupped hands a mixture of fluid, solid, and gas and then, through an opening at the bottom, try to let only the gas escape, you will fail. Yet the sphincter ani can do it. The sphincter apparently can differentiate between solid, fluid, and gas. It apparently can tell whether its owner is alone or with someone, whether standing up or sitting down, whether its owner has his pants on or off. No other muscle in the body is such a protector of the dignity of man, yet so ready to come to his relief. A muscle like this is worth protecting."

Physiology: The rectum has little importance in digestion, and acts as a reservoir or collecting tube for undigested waste. The most important physiologic function of the rectum and anus is in the controlled act of defecation (i.e., continence).

Clinical Signs: Common clinical signs associated with diseases of the anus and rectum include: dyschezia, hematochezia, tenesmus, anal licking, ribbon-like stools, matting of anal hair, anal discharge, scooting, excessive
flatulence and diarrhea. Patients that present with any of the above clinical signs should have a thorough physical examination with emphasis on the anorectal region, including a digital rectal examination.

Physical Examination: A complete physical examination should be performed in all patients with clinical signs specific for anorectal disease in order to rule out systemic disorders that manifest themselves with anorectal abnormalities (i.e., pemphigus).

Specific examination of the anorectal region should include close visual examination of the perineum, circumanal area, and base of the tail, as well as careful digital rectal palpation. In many instances this may be all that is necessary to obtain a definitive diagnosis. If a more detailed examination is needed, the use of an anal dilator or proctoscope may be indicated.

These techniques require heavy sedation or general anesthesia to adequately perform. Epidural anesthesia has proven to be an effective anesthetic regime for examination of the anus and rectum. Excellent muscle relaxation allows easy anal sphincter dilation and visualization of the anal canal and rectal mucosa. The patient is placed in a perineal position for examination.

Sphincter muscle atonia or areflexia: This form of incontinence occurs when the peripheral nervous supply to the external anal sphincter muscle or the muscle itself has been partially or totally severed. The external anal sphincter muscle is made up of striated muscle fibers, and is partially responsible for the voluntary control of defecation.

Isolated injury of the pudendal nerve to the external anal sphincter is uncommon, but may occur from iatrogenic causes. Injury can occur during the following surgical procedures:
1. Perianal fistula repair-cryosurgery or excision
2. Perianal gland adenoma removal-cryosurgery or excision
3. Perineal hernia repair
4. Anal saccullectomy
5. Anoplasty procedures
6. Removal of malignant neoplasm

When this type of injury occurs, the patient may still be considered an appropriate house pet. With loss of anal sphincter tone, fine control of defecation is lost, but the patient still has the ability to sense the urge to defecate and can position properly. However, the fine control necessary to terminate a bowel movement without dropping a piece of stool is compromised. Also, when the patient is excited, startled, or barks loudly causing increased intra-abdominal pressure; a piece of stool may drop out of the rectum. The important thing to remember is that the patient retains the urge to defecate and can control, to some extent, bowel movements.

Anal Sacculitis: Anal sac impaction and abscessation is the most common anorectal disorder diagnosed by the small animal practitioner. Diagnosis is confirmed by clinical signs, visual and digital rectal examination. Relief of impaction by digitally expressing the anal sacs is easily performed during rectal examination. If abscessation is present, infusion of an antibiotic preparation may be sufficient to eliminate the infection. Systemic antimicrobial treatment may be required in resistant cases. If abscessation becomes a chronic recurrent problem, surgical excision of both anal sacs is the treatment of choice. Surgery should be delayed however until the immediate infection or abscess has been controlled medically as described above.
**Surgical Techniques:** There are a variety of techniques currently used to successfully remove anal sacs. One such technique includes using a pair of Metzenbaum scissors to cut into the anal sac through the duct. The sac is opened to expose the glistening greyish colored interior lining. Hemostats are used to grasp the full thickness of the anal sac wall, being careful to avoid the external anal sphincter muscle fibers. A number 15 BP scalpel blade is used to carefully scrape the gland from the underlying external anal sphincter muscle. The external anal sphincter m., subcutaneous tissue and skin are closed with a synthetic absorbable suture material in a simple interrupted pattern.

An alternate method is to incise over the anal sac, dissect through the subcutaneous tissue, locate the sac and excise it toward the duct.

Regardless of the procedure used, if the entire anal sac is removed and the caudal rectal nerve avoided the prognosis is excellent.

**Foley Catheter Technique (the authors’ preferred technique)**
A novel approach for safely and completely removing anal sacs relies on the use of a 6 French Foley catheter with a 3cc bulb. The Foley catheter is placed into the anal sac through the anal sac orifice and its cuff inflated. Once introduced into the sac, the Foley catheter bulb is inflated with 2-3 cc of air or saline. The bulb distends the anal sac making identification and palpation of the gland simple. The protruding catheter allows the surgeon, or the surgeon’s assistant, to place gentle traction on the gland during dissection. A 360-degree skin incision is made around anal sac duct and the protruding catheter. Care is taken to leave at least 2mm of skin from the anal sac duct and the incision. Metzenbaum scissors (curved) are then used to dissect to the plane of tissue between the anal sac wall and external anal sphincter. Identification of the wall is made by identifying its grayish color in comparison to the deep red color of external anal sphincter muscle fibers that will be carefully dissected off of the anal sac wall. As the dissection progresses constant traction is placed on the Foley catheter to accentuate to sac. When performing the deep dissection of the sac wall care is taken to make certain the dissection does not go deep to the sac wall. This is the location of the caudal rectal nerve fibers. Dissection is continued until the sac is completely dissected free and removed from its surrounding tissue.

Closure consists of suturing together any cut fibers of the external anal sphincter muscle with 3-0 Maxon and the skin closed with 4-0 Biosyn using an intradermal technique. This is the authors preferred technique for anal sacculectomy.

This technique is illustrated on the Anal Sacculectomy video located in the GI Surgery I DVD. Check it out at [www.videovet.org](http://www.videovet.org).
Wound Management Secrets

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Split-shot Wound Management

Key Points

• Skin has the ability to stretch when placed under mild tension
• Normal wound contraction often stops before wound edges appose.
• Split-shot wound management can be used to encourage skin edges to contract.

Indications: Use of various appliances to create tension on the local skin of non-contracting open wounds is not new. Subcutaneously buried silastic balloons (i.e., skin expanders) injected every 24 hours with varying amounts of saline will stretch local skin and have been used extensively in human plastic and reconstructive surgery. Skin expanders have also been described for use in veterinary patients. Skin expansion may be indicated in wounds that have undergone normal wound contraction without successful wound margin apposition. The most common locations for inappropriate wound contraction in small animals are extremities, head, and tail.

Applied Anatomy: Skin is made up of several layers that collectively form a complex organ system. Skin is not capable of regeneration. One method of getting ‘more’ skin for wound coverage is encouraging local skin to undergo intussusceptive growth. This can be accomplished by applying tension to local skin around the wound. If tension is constant, skin layers will accommodate the increase tension by becoming thinner thus allowing the skin to ‘stretch’.

Anesthesia: Patients undergoing split-shot wound management should be placed under general anesthesia.

Technique: Positioning: Patients are positioned with the wounded area uppermost.

Patient preparation: Wounds identified for split-shot wound management should be treated as an open wound until there is evidence of a healthy granulation tissue bed. Routine aseptic preparation of the local skin is performed.

Special instruments and suture: Metallic split-shot (i.e., other than lead) can be purchased at any local sporting goods or fishing store. Split-shots are placed in a cold sterilization media for an appropriate time period and thoroughly rinsed prior to use. Monofilament non-absorbable suture with a swaged-on taper needle, size 00 to #1 depending upon location and size of wound is recommended. A sterile rubber bumper is fashioned from a feeding tube or catheter.

Split-shot technique: The wound and surrounding skin are prepared for aseptic surgery. Two bumpers are created by cutting one 1/2 inch piece off the flanged end of a 20 French feeding tube or catheter. This segment of tube is then split in two.

An appropriate size monofilament nonabsorbable suture is selected. The skin edges are gently undermined being careful not to trim the wound edge. The swaged-on needle is placed through the rubber bumper and enters the wound at the commissure. The wound edges are then sutured using a simple continuous
pattern. Care is taken to engage the needle in the tough collagen laden subcutaneous tissue. Patients with thin subcutaneous tissue (i.e., cats, small dogs, areas of thin skin) may require penetration of skin instead of subcutaneous tissue. Once the entire length of the wound has been sutured, the suture is passed out through the skin of the remaining commissure of the wound. Knots are not tied in either end of the suture.

Gentle traction is placed on the exiting ends of the suture until mild tension is placed on the wound edges and local skin. A split-shot is placed on each end of the exiting suture against the bumper. The split-shot is then gently but firmly clamped against the suture; this maintains tension on the skin edges and local skin. The wound is bandaged, an Elizabethan collar placed, and the patient confined to a cage. Each day the bandage is removed, the ends of the suture gently pulled and a split-shot is placed between the bumper and the original split-shot. Daily tension is performed without the need for general anesthesia or sedation. Skin may be responsive to tension for 7 to 10 days. When the wound is closed to your satisfaction, the suture and bumpers are removed. The remaining wound is bandaged only if it requires further protection.

**Tie-over Bandage Technique**
If you would like a copy of the illustrated version of these notes on CD and a video of this surgical procedure on DVD, go to [www.ivseminars.com](http://www.ivseminars.com) and click VideoVet or contact videovet@me.com.

**Key Points**
- The most important aspects of wound management are debridement, debridement, debridement.
- The solution to pollution is dilution.
- A tie-over bandage can cover the most difficult to bandage wounds.
- A tie-over bandage can help ‘stretch’ local skin.

If you would like an instructive DVD of this topic, go to [www.ivseminars.net](http://www.ivseminars.net) and click on Video Vet.

**WOUND MANAGEMENT**: The area should be clipped and cleaned as soon as possible to provide a clean environment beneath the bandages that will eventually be applied. Sterile, water soluble gel placed on the wound is a convenient means of temporary wound protection. Dried blood and debris should be removed from the surrounding skin with antiseptic soap, using care to avoid contact between the soap and exposed tissues which can result in lipolysis and tissue damage. The primary goal of wound management is to decrease bacterial numbers and debris and enhance the animal’s defense mechanisms (i.e., debridement). Gross particulate matter, hair, etc. should be removed manually from the wound. Lavage is beneficial in further decreasing infection-promoting debris and bacteria. Saline is indisputably the ideal lavage solution, although dilute chlorhexidine (0.05 to 0.005%), or povidone-iodine (0.01%) may be used. The effectiveness of lavage is dependent upon volume and pressure. Studies have shown that high pressure (25-60 psi) is superior to low pressure (0.5-5.0 psi) when wounds are only lavaged one time. Medium pressure, which has also been shown to be beneficial can be generated using an 18 gauge needle and large syringe (35-60 ml). Surgical debridement of necrotic-appearing tissue and embedded foreign material limits nutrients for bacterial growth and enhances the animal’s local defense mechanisms.

**OPEN WOUND MANAGEMENT**: Open wound management allows optimal drainage and daily inspection, debridement and lavage of tissues. Following surgical excision of necrotic tissue, etc., continued mechanical debridement can be performed using an adherent dressing (wet-to-dry, dry-to-dry, or wet-to-wet). Wide-mesh gauze sponges are ideal for adherent bandages. The type of dressing used depends on wound conditions. Wet-to-dry dressings can be used for wounds with necrotic tissue, foreign matter and viscous exudate. The wet dressing dilutes the exudate and allows absorption. As the dressing dries, necrotic tissues adhere to the gauze and are removed with the bandage. Dry-to-dry dressings have similar indications as wet-to-dry except without
the presence of viscous exudate. Wet-to-wet dressings are indicated when viscous exudate is present without necrotic tissues. The contact adherent layer should be covered by an absorbent outer layer. Once necrotic tissues have been removed and granulation tissue begins to form, adherent gauze should be replaced with nonadherent pads (telfa).

SECOND INTENTION HEALING: Second intention healing occurs by formation of granulation tissue, wound contraction and epithelialization. The advantages of this process are drainage remains optimal, wound infections are rare and the time and expense of surgery is avoided. However, second intention healing may cause disfigurement or loss of function due to wound contracture, and the epithelium formed may be easily disrupted.

TIE-OVER BANDAGE: Indications: Large surface area wounds (i.e., abdomen, thorax, back, neck) or wounds in ‘difficult-to-bandage’ areas (i.e., tail, perineum, head, pararepucial, proximal extremities) may not be amenable to routine bandaging techniques. These areas generally lend themselves nicely to placement of a tie-over-bandage.

Technique: The wound bed is prepared as described above. Several #0 or #1 monofilament non-absorbable suture loops are placed in the skin on the periphery of the wound. Loop sutures are generally placed 360° around the wound and spaced 2 or 3 cm apart. Appropriate wound covering materials are placed in the wound bed (i.e., wet to dry, gauze, telfa, etc) and a sterile laparotomy pad placed on top to provide protection to the wound. Several lengths of 1/4 inch or 1/2 inch umbilical tape are passed through the loops of suture, over the laparotomy pad and through the suture loop on the opposite side of the wound. The umbilical tape passes over the wound multiple times to hold the laparotomy pad in place (an therefore the wound covering materials). Enough traction is placed on the suture loops to place mild tension on the skin edges of the healing wound. This bandage is easily removed and replaced for ease of bandage change. Once the granulation bed is healthy and the wound is considered surgically clean it can be closed primarily (i.e., delayed primary closure). If there are small defects at the time of suture removal these can generally heal by second intention.