ANAL SACCULECTOMY; A NOVEL APPROACH

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Key Points

- knowledge of anorectal anatomy and neuroanatomy is important to protect vital structures
- remove all anal sac epithelium during anal sacculectomy
- use a Mila Anal Sac catheter or 6F Foley 3cc bulb catheter to facilitate anal sacculectomy

If you would like a video of this surgical procedure go to www.videovet.org or contact videovet@me.com. You may click on the 'Seminar Price' for any surgery video 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 and caudal rectal nerve.

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."

Clinical Signs: Common clinical signs associated anal sacculitis include: anal licking, matting of anal hair, anal discharge and scooting. 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.

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 caudal rectal nerve to the external anal sphincter is uncommon but may occur from iatrogenic causes. Injury can occur during overzealous anal sacculectomy. The caudal rectal nerve originates from the pudendal nerve which lies on the internal obturator muscle deep in the pelvic canal. Injury during anal sacculectomy is therefore caused during the final 'deep' dissection of the anal sac rather than during the initial dissection. Thus deep dissection is when the surgeon must use exceptional care during dissection of the anal sac.

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 an anal sac abscess is present, infusion of an antibiotic preparation may be sufficient to eliminate the infection. Systemic antimicrobial treatment may be required in resistant cases. If the anal sac abscess 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 for Anal Sac Removal: There are a variety of techniques currently used to successfully remove anal sacs. The best approach would be one that allows constant palpation of the extent of the anal sac and also allow retraction of the anal sac during dissection. One such technique is described below:

MILA Anal Sac Catheter Technique (the authors' preferred technique) or 6 French Foley Catheter with a 3cc bulb Technique:

A novel approach for safely and completely removing anal sacs relies on the use of a 6 French balloon catheter with a 3cc bulb (MILA or Foley). The author prefers the MILA 6 French anal sac catheter as it is specifically designed to fit in the canine anal sac. The anal sac catheter is placed into the anal sac through the anal sac orifice and its cuff inflated. Once introduced into the sac, the 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) or Stevens tenotomy scissors (curved) are then used to dissect to the plane of tissue between the anal sac wall and external anal sphincter muscle. Identification of the anal sac 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 anal sac 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 apposed 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 surgery video. Check it out at www.videovet.org.

An alternate 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 laterally 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.

SURGICAL MANAGEMENT OF CANINE CALCULI

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If you would like a copy of the video of these surgical procedures go to **www.videovet.org.**

Key Points

- 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.

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 crystalluria.

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: Go to www.videovet.org for a detailed video of this technique. This technique should result in a 90-95% success rate of retropulsing even the most difficult 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 dialates the urethra); repeat the above maneuvers and when maximum pressure is exerted on the urethra by the saline/lubricant mix (i.e., the urethral is maximally dialated), suddenly release digital urethral occlusion allowing lodged calculi to flush into the urinary bladder.

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 monitered 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 a 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 disected 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.

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: Go to www.videovet.org for a 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 controling 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 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. This method is preferred by the author over healing by second intention as postoperative hemorrhage is significantly reduced.

Alternatively, 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.

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

Scrotal urethrostomy: Go to www.videovet.org for a 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 convienent 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 efficent 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: Go to www.videovet.org for a 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 prepucal 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 similarily asepticlly 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 plced 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 susceptability testing. The interior of the bladder is examined for urachael diverticulm, 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 urethrostomy 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!). Tranqulization 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!). Tranqulization 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 incorproating 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. Tranqulization 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 evaluaiton 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 GDV

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

Key Points

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Stand on the right side of the patient.

Provide generous abdominal exposure via xyphoid to pubis midline laparotomy.

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

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

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

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

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

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

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

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

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

Commence your gastropexy procedure.

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

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

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

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

Postoperative management

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

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

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

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

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

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

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

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

Sari H. Touru and Daniel D. Smeak

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

Käytännöllinen oikeanpuoleinen viiltogastropeksia mahalaukun laajentumisen ja kiertymisen hoitona tai ennaltaehkäisynä

SUMMARY

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

YHTEENVETO

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

INTRODUCTION

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

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

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

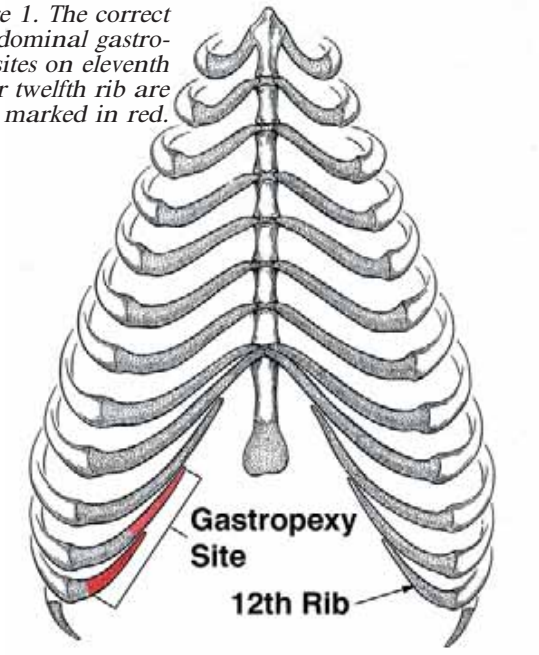
The objective of this article is to illustrate a novel gastropexy technique that incorporates the raw muscle surfaces between the stomach and abdominal wall, and that is very safe and quick to perform in our hands. Incisional gastropexy is one of the easiest of the techniques previously listed, especially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

TECHNIQUE

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

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

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



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

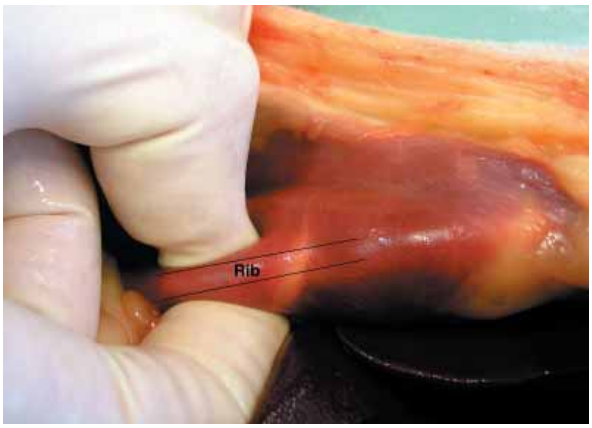


Figure 2. The twelfth rib is palpated and fixed between fingers.

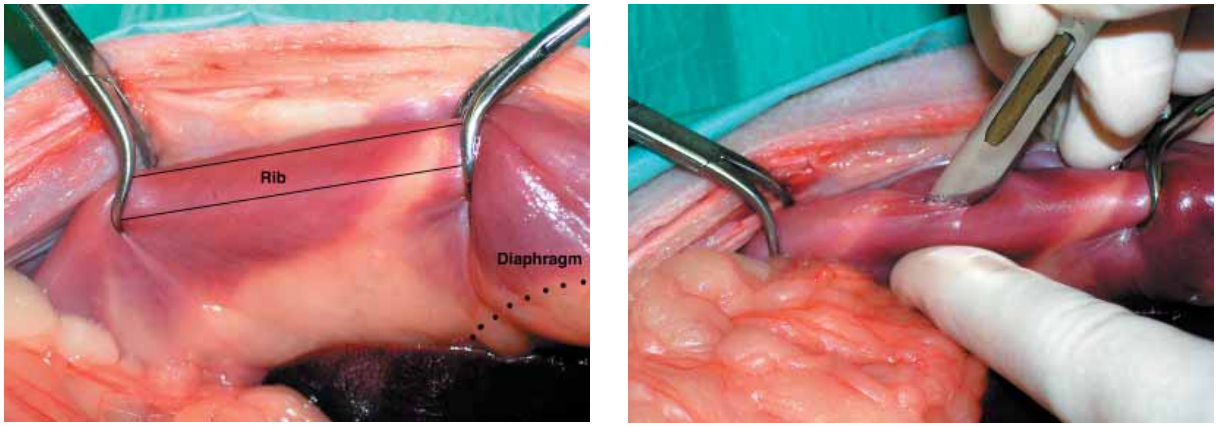


Figure 3. Transverse abdominal muscle is incised on top of the rib which is held by towel clamps.

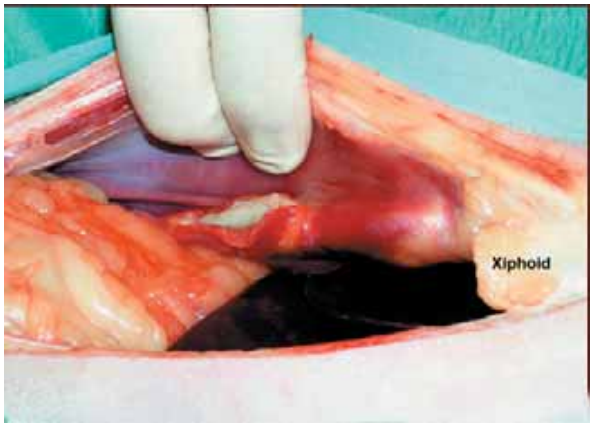


Figure 4. Towel clamps are removed after the incision is completed. Note that the correct site of the incision is several centimetres caudal to xiphoid.

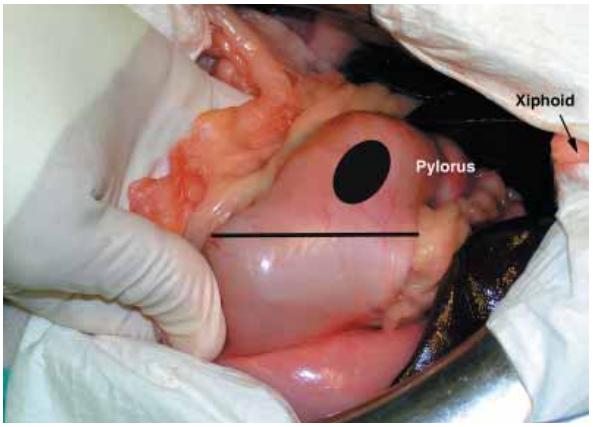


Figure 5. The correct stomach gastropexy site, marked with an ellipse, is midway to the pylorus and lesser curvature line.

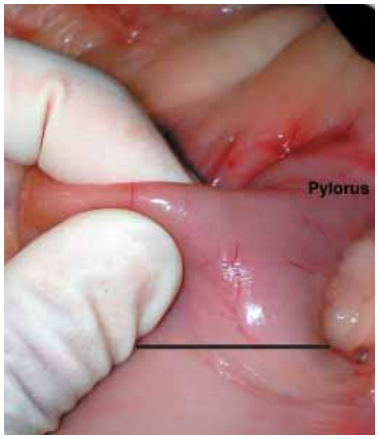


Figure 6. The stomach is pinched between fingers and lifted up to let the mucosa slip away.

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

Figure 7. The stomach is cut with Metzenbaum scissors.

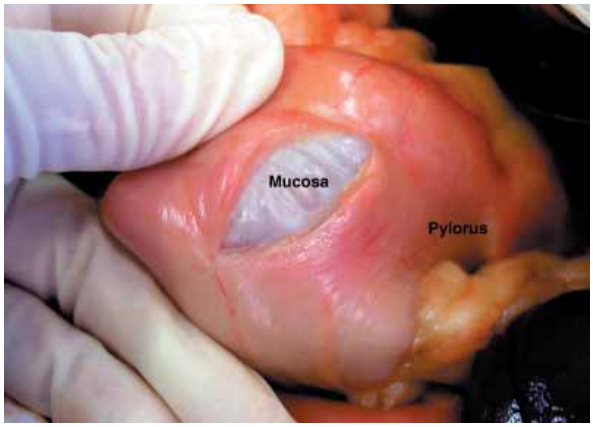


Figure 8. After cutting the stomach mucosa is intact and pulping out from incision.

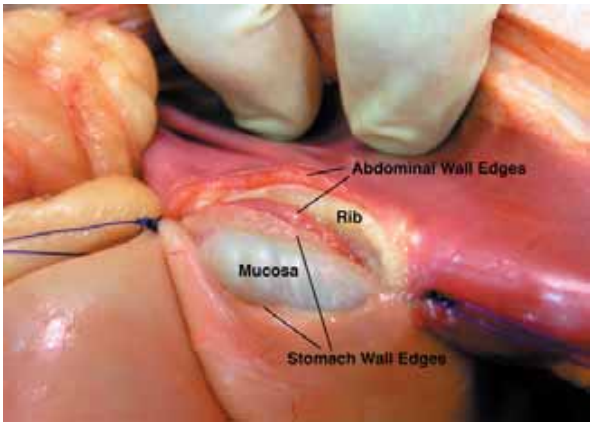


Figure 9. Stay-sutures are knotted and gastropexy wounds, that are about to be sutured, are appositioned.

towel clamps (Fig. 4).

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

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

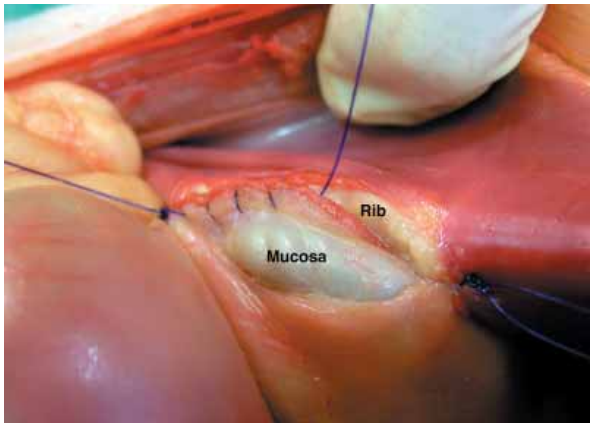


Figure 10. The caudal edge of the stomach wound and the dorsal edge of the abdominal wall is sutured with a simple continuous suture pattern.

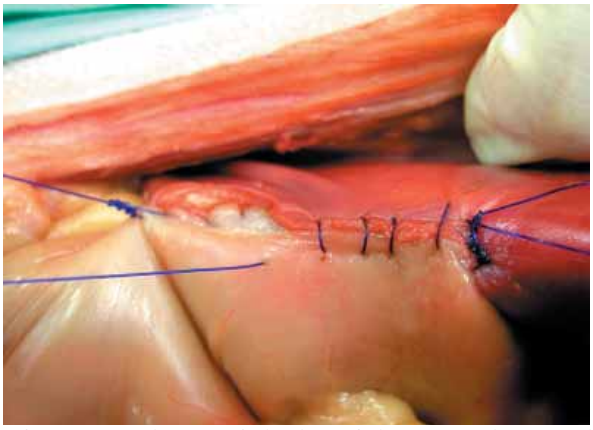


Figure 11. The cranial edge of the stomach wound and the ventral edge of the abdominal wall is sutured similar to the first line.

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

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

CONCLUSIONS

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

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

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

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SURGICAL MANAGEMENT OF GI LINEAR FOREIGN BODIES

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

Linear foreign bodies

Clinical presentation: Linear foreign bodies (e.g., string, plastic bags, tinsel, tape deck tape, yarn, thread) occur in the dog and cat. The classic presentation is a patient four years of age or less with persistent vomiting, anorexia, and depression. These signs are common with many gastrointestinal disturbances and linear foreign body should be included in your differential diagnosis. Occasionally, patients are presented late in the course of the disease and may have a history of intermittent vomiting with anorexia, depression, and weight loss as the major presenting signs.

Diagnosis: A thorough physical examination should be performed with emphasis on oral examination and abdominal palpation. Oral examination often reveals the linear foreign body around the base of the tongue in cats. The foreign body itself may be seen or an area of inflammation may be present at the junction of the base of the tongue and frenulum. _ Abdominal palpation may reveal "bunched-up" small intestine due to the plication. When this finding is made, the clinician should be very gentle with further abdominal manipulations so as not to encourage bowel perforation.

Radiography: Definitive diagnosis is based on characteristic findings on survey and contrast radiography. Survey radiographs may reveal plicated bowel bunched up in one quadrant of the abdomen. Due to its plicated nature, air accumulation in the bowel lumen forms a characteristic "tapered enteric gas bubble". Three or more tapered gas bubbles are diagnostic for linear foreign body. Evidence of peritonitis (i.e., ground glass appearance), free gas in the abdominal cavity, ileus, or the presence of a needle are findings that may be present on survey radiographs. Patients with subtle changes or questionable findings should have an upper gastrointestinal contrast study (e.g., barium 6.6-11 ml/kg). The typical plicated appearance of the bowel is diagnostic for linear foreign body

Presurgical treatment: Surgery for the removal of linear foreign bodies should be accomplished as soon as possible. Presurgical preparation of patients diagnosed early and in good health include an intravenous catheter, maintenance fluids, replacement of fluid loss from vomiting and dehydration and antibiotics prior to abdominal exploratory. Patients that present in septic shock (i.e., perforation, peritonitis, severe dehydration) should be treated with replacement fluids, antibiotics. Electrolytes (chloride, potassium, sodium) and acid-base evaluation are helpful in presurgical management. When fluid losses have been replaced and shock therapy instituted the patient is anesthetized for abdominal exploratory.

Surgical treatment: After xyphoid to pubis celiotomy, the plicated bowel is gently

exteriorized from the abdominal cavity**.** In order for a linear foreign body to result in intestinal obstruction and clinical signs, it must be lodged somewhere in the proximal gastrointestinal tract. Common areas include: base of the tongue (i.e., string is often looped around the base of the tongue), stomach or pylorus (i.e., a ball of string is often lodged at the pylorus), or duodenum (i.e., the string becomes impacted in the descending or ascending duodenum). The surgeons first task is to locate the area in which the foreign body is lodged and release it. If it is lodged under the tongue it should be cut at the time of exploratory laparotomy; if it is lodged in the stomach or pylorus, it is released via a gastrotomy; if it is lodged in the duodenum, it is removed via enterotomy.

Once the proximal end is released, the extent of the linear foreign body is evaluated, and 2-3 subsequent jejunal enterotomies are performed to remove the remainder of the foreign body.

Care is taken to remove the linear foreign body in segments short enough that further cutting of the mesenteric border of the intestine does not occur during removal, yet long enough to perform a minimum number of enterotomies. These numbers and distances vary with the type and length of linear foreign body involved. The mesenteric border is examined carefully for evidence of perforation. All linear foreign bodies should be removed to the level of the ascending colon. Colotomies are **not** necessary, as once the linear foreign body is in the colon it can be passed with little danger of causing obstruction.

An alternate technique for removal of a linear foreign body is to identify and release the obstructed proximal aspect of the foreign body and attach the released end of the linear foreign body to the flanged end of a 12 - 18 French red rubber catheter/feeding tube. Pass the blunted end of the catheter into the gastrotomy or enterotomy and pass it aborally through the entire length of the intestinal tract and out through the anus. As the catheter is passed, it pulls the linear foreign body out of the GI tract and releases the bowel from its plication. This technique eliminates the need for multiple enterotomies to remove the foreign body. Difficulty can arise when attempting to pass the catheter through the small intestine. Care should be taken not to encourage further trauma to the mesenteric border while passing the catheter.

After the foreign body has been completely removed, a close examination of the mesenteric border is made for evidence of perforation. Any perforation should be debrided and sutured. If multiple perforations occur, a resection and anastomosis may be necessary. Serosal patching may be considered to protect an anastomosis or enterotomy site in a compromised patient. Serosal patching is not recommended to patch mesenteric perforations as suturing the patch may result in vascular compromise to the affected intestinal segment.

Patients with multiple mesenteric perforations that cannot be sutured without severely compromising bowel viability should undergo massive bowel resection. Remember, you can successfully resect 60 - 70% of the small intestine and have a nutritionally acceptable animal. If the client is willing to treat their dog or cat with an acid blocking

agent, this resection can be expanded to a 75 - 80% small intestinal resection.

The abdominal cavity is lavaged with copious quantities (e.g., 200-300 ml/kg) of sterile physiologic saline solution prior to closure. Placement of a feeding tube should be considered in severely debilitated patients. Postoperative management (i.e., fluids, antibiotics, feeding) is as previously discussed.

Closure of the peritoneal cavity in patients with peritonitis
Prior to abdominal closure, especially in cases with peritonitis secondary to intestinal perforation, the peritoneal cavity should be lavaged with copious quantities (200-300 ml/kg body weight) of sterile physiologic saline solution.

Cases that require postoperative drainage, the use of Jackson Pratt drains offer an efficient means of post operative peritoneal drainage. These drains should be placed in the crania abdomen between the liver and diaphragm. Large dogs (>40 lbs) should have a second drain placed in the caudal abdomen. Drains should always be exited from the abdomen at a point distant from the midline abdominal incision. Abdominal wall closure is generally performed using absorbable or nonabsorbable monofilament suture material in a simple continuous pattern.

Prognosis: Prognosis for patients with linear foreign body is directly related to the presence or absence of bowel perforation at the time of surgery. Patients without preoperative perforation have an 85% chance of survival while those with preoperative perforation have only a 50% chance of survival. This survival rate further reinforces the importance of early diagnosis and surgical treatment.

SPLENECTOMY

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INTRODUCTION

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

INDICATIONS

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

PATIENT POSITIONING

The patient is placed in dorsal recumbency for routine celiotomy.

RECOMMENDED INSTRUMENTS

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

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

SURGICAL TECHNIQUE

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

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

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

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

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

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

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

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

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

POSTOPERATIVE CONSIDERATIONS

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