Feline Esophagostomy Feeding Tube Placement and Wound Management Secrets
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Key points
• feeding tubes should not pass the LES
• “if the gut works, use it”
• learn how to do a Chinese finger trap friction suture
• keep a column of water in the tube between feedings

As a general rule, the closer one comes to the oral route of food intake and digestion, the more efficient is the assimilation and digestion of nutrients and the greater the flexibility in formula composition. Conversely, the further aboral one gets, the less efficient is the assimilation and digestion of nutrients and greater care must be taken when choosing formula composition. Route of administration also dictates feeding tube diameter; tube diameter in turn dictates usable feeding formulas due to varying formula viscosity and particulate matter size. The most common routes of administration for enteral hyperalimentation include oral, nasoesophageal, esophagostomy, gastrostomy, and jejunostomy. Techniques for placement of an esophagostomy feeding tube will be presented.

Esophagostomy

Indications
Esophagostomy tube feeding is indicated in anorexic patients with disorders of the oral cavity or pharynx, or anorexic patients with a functional gastrointestinal tract distal to the esophagus.

Contraindications
Esophagostomy tube placement is contraindicated in patients with a primary or secondary esophageal disorder (e.g., esophageal stricture, after esophageal foreign body removal or esophageal surgery, esophagitis, megaesophagus) and patients with a history of vomiting.

Advantages
Advantages of esophagostomy tube feeding include ease of tube placement, tubes are well tolerated by the patient, large bore feeding tubes can be used allowing use of blenderized diets, tube care and feeding is easily performed by the client, patients can eat and drink around the tube, and tube removal can be performed anytime after placement. Esophageal tube placement eliminates local pharyngeal irritation, coughing, laryngospasm, or aspiration occasionally associated with pharyngostomy tubes.

Disadvantage
The major disadvantage of esophagostomy tube is the need for general anesthesia during placement.

Placement technique
Provide general anesthesia. Place the patient in right lateral recumbency with the left side uppermost. The tube can be placed on either the right or left side of the midcervical region, however the esophagus lies slightly left of midline making left sided placement more desirable. Aseptically prepare the lateral midcervical area from the angle of the mandible to the thoracic inlet. Slightly extend the neck and hold the mouth open with a mouth speculum.

Pre-measure and mark a 20 to 24 French feeding tube for dogs and a 16 – 18 French feeding tube for cats from the level of the midcervical region (i.e., exit point of feeding tube) to the level of the seventh or eighth intercostal space; ensuring mid- to caudal esophageal placement. Make certain the tube does not cross the lower esophageal sphincter (LES) as this may cause sphincteric incompetence, gastric reflux of acid, esophagitis and subsequent vomiting or regurgitation. Prior to tube placement, enlarge the two lateral openings of the feeding tube to encourage smoother flow of blended diets.

Eld esophagostomy tube placement technique
The following technique requires the use of an Eld feeding tube placement device and is illustrated in the esophagostomy video labeled E-tube. Place the oblique tip of the instrument shaft through the oral cavity and into the esophagus to the level of the midcervical region (i.e., equal distance between the angle of the mandible and thoracic inlet) and palpate the tip as it bulges the cervical skin. Make a small skin incision over the device tip. Activate the spring loaded instrument blade until it penetrates esophageal wall, cervical musculature, subcutaneous tissue and is visible through the skin incision. Carefully enlarge the incision in the subcutaneous tissue, cervical musculature and esophageal wall with the tip of a #15 scalpel blade to allow penetration of the instrument shaft. Place a 2-0 Nylon suture through the side holes of the feeding tube and through the hole in the instrument blade. Tighten the suture until the tip of the instrument blade and feeding tube tip are in close apposition. Retract the instrument blade into the instrument shaft so the feeding tube tip just enters the instrument shaft (i.e., deactivating the instrument blade. Place sterile water-soluble lubricant on the
tube and instrument shaft. Retract the instrument and pull the feeding tube into the oral cavity to its predetermined measurement. Remove the 2-0 Nylon suture to free the feeding tube from the instrument. Place a stylet through one of the side holes of the feeding tube and against its tip (do NOT use a stylet when placing an E-tube in cats). Lubricate the feeding tube and advance it into the esophagus until the entire oral portion of the tube disappears. Gently retract the stylet from the oral cavity being careful to ensure its release from the feeding tube. If you encounter resistance and cannot pass the feeding tube into the esophagus you may have engaged the endotracheal tube. If this happens remove the feeding tube and replace it under direct visualization. Secure the tube to the cervical skin with a Chinese finger-trap suture of #1 Novafil.

Curved Carmalt hemostate technique
Instead of the Eld device a curved Carmalt hemostat can be used to place an esophagostomy feeding tube. Patient and feeding tube preparation is identical to that stated above for the Eld technique.

The curved Carmalt forceps is placed into the cat's oral cavity with the curve of the hemostate directed toward the cervical region. The Carmalt is directed to a point equidistant between the ramus of the mandible and point of the shoulder midway between the dorsal and ventral aspect of the neck. The hemostat is pushed laterally so as to make a ‘buldge’ in the cervical region at the desired exit point described above. A scalpel blade is used to incise over the tip of the Carmalt until the tip protrudes through the skin. The tip of the feeding tube is then grasped with the Carmalt hemostat and the tube is exited out through the oral cavity. The tube is pulled out until the flanged end of the tube just comes in contact with the cervical skin. The tip of the tube is then turned back on itself, grasped with the Carmalt forceps, and redirected into the oral cavity of the cat. The tube should remain in the jaws of the Carmalt hemostat until the tip of the tube is beyond the cervical exit point of the tube. The feeding tube is then released from the Carmalt and pushed into the esophagus until the tube is in the mid-esophagus (i.e., 7 or 8th intercostals space). The tube is secured using a Chinese finger-trap friction suture.

Regardless of technique used, the exit point of the tube can be left exposed or bandaged. A column of water is placed in the tube and the exposed end capped with a 3 cc syringe; this prevents intake of air, reflux of esophageal contents, and occlusion of the tube by diet. Most patients tolerate the tube without the need of an Elizabethan collar.

Esophagostomy tubes can be removed immediately after placement or left in place for several weeks to months. Care of the tube exit site may require periodic cleansing with an antiseptic solution. Tube removal is performed by cutting the finger-trap suture and gently pulling the tube. No further exit wound care is necessary; the hole seals in one or two days and heals by 7 - 10 days.

Complications
Complications associated with esophagostomy tube placement include early removal by the patient or vomiting the tube. No significant long-term complications have been reported (e.g., esophagitis, esophageal stricture, esophageal diverticulum, or subcutaneous cervical cellulitis). Reflux esophagitis can occur from improper tube placement (i.e., through the lower esophageal sphincter) or esophageal irritation from the tube itself. Mid-esophageal placement of silicone rubber tubes greatly reduces the incidence of esophageal injury and eliminates reflux esophagitis.
Key points
• Don’t let the sun set on a GI obstruction
• Always look under the tongue in suspected linear FB
• Multiple enterotomies may be needed
• Surgery prior to mesenteric perforation improves prognosis dramatically

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 and click VideoVet or contact videovet@me.com.

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. 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 (22 ml/kg TID), 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 a graduated replacement of fluids (as needed up to 90 cc/kg IV) and antibiotics (cefotixin, ampicillin and enrofloxacin, or gentamicin and ampicillin). 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 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 enterostomy feeding tube should be considered in severely debilitated patients. Postoperative management (i.e., fluids, antibiotics, feeding) is as previously discussed.

**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 treat

References
Feline Perineal Urethrostomy: A Novel Approach
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Key points
- Patients with cystic and 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) 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, sex or breed predisposition.

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, blood tinged urine in the litter pan, 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 seen in the litter pan, 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
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/or crystalluria. Patients presenting after several days of complete obstruction may have significant changes in their biochemical profile including increased BUN, increased creatinine, metabolic acidosis, and severe electrolyte abnormalities. Urine is generally grossly hemorrhagic and urinalysis may show signs of urinary tract infection and crystalluria.

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. Careful radiographic evaluation of the kidneys and ureters should be done to rule out renal and ureteral calculi.

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 long enough to cause azotemia, temporary urinary diversion is provided by 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.

Urethral catheterization of a female cat
- Female urethral catheterization is easier than male
- Use a closed ended tom cat catheter
- Ventral recumbancy is recommended
- Pass the catheter with no evidence of resistance

Retrograde hydropulsion of lodged urethral calculi

Calcus removal
Retrograde hydropulsion: This technique should result in an 80-85% success rate for retropulsing urethral calculi into the urinary bladder!

- Thoroughly mix 20 cc of sterile saline and 5 cc of Surgilube or K-Y Jelly in a 35 cc syringe and attach the syringe to a 3.5 - 5.0 French soft rubber catheter/feeding tube.
- Anesthetize the patient, 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.
- Using a back and forth action on the catheter, simultaneously inject the saline/lubricant mix under extreme pressure.
  a) 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.
  b) This technique is attempted, and generally successful, regardless of how many stones are in the urethra and no matter where they are lodged.

If the above technique fails, use a stiffer catheter (i.e., open or closed ended tomcat catheter) and repeat the above maneuvers. Use care when manipulating these stiffer catheters against the calculus.

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 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 feline 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 blood filled corpus cavernosum urethra 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, cystostomy tube placement and routine cystotomy.

Urethrostomy
Urethrostomy is generally performed in patients that are recurrent stone formers. It provides a permanent opening that is large enough to accommodate passage of most urethral calculi, crystals and mucoid debris.
Perineal urethrostomy; perineal approach

The perineal urethra is the location of choice for urethrostomy in cats. It is a convenient location for surgical manipulation, the urethral diameter will accommodate passage of most urethral calculi and there is less urine scald postoperatively.

Prior to surgery a urethral catheter is passed, if possible. After a routine castration, an elliptical incision is made around the scrotum and penis. Then the subcutaneous tissues are dissected to expose penis urethra. The penile urethra is dissected free from surrounding connective tissue. The ventral attachment of the pelvic urethral to the pubis (i.e., ishiocavernosus m.) is identified and transected. The penile urethra is freed from its connective tissue attachments to the pelvic floor using blunt digital dissection. The retractor penis muscle is identified on the dorsal aspect of the penis and is dissected from its attachment on the penis. The dissected retractor penis muscle is then used to develop the dorsal plane of dissection to separate the pelvic urethra from its dorsal connective tissue attachments. Once the urethra is dissected enough to visualize the dorsolaterally located bulbourethral glands penile dissection can stop. The penis is catheterized and the urethral orifice identified. An incision is made from the penile urethra to the pelvic urethral to the level of the bulbourethral glands using a Stevens tenotomy scissor or Iris scissor. The urethral orifice at the level of the bulbourethral glands is generally of large enough diameter to accept the flange of a tomcat catheter.

After incision of the urethra, the glistening urethral mucosa is identified. 5-0 nonabsorbable monofilament suture with a swaged on cutting or taper-cut needle is recommended by the author. The first urethrostomy suture is placed at the dorsal aspect of the urethrostomy incision on the right or left side at a 45° angle to include urethral mucosa and skin (suture split thickness of skin). The suture is tied and cut leaving the ends 3-4 cm long to act as a stay suture. A mosquito hemostat is placed on this suture to provide traction and countertraction to enhance visualization of the urethral mucosa. The second suture is placed opposite the first suture and tied as described for the first. A stay suture is also placed here. A third urethrostomy suture is placed directly on the dorsal midline to hold the dorsal margin of urethral mucosa to the dorsal margin of the skin incision. Alternating sutures from dorsal to ventral are placed until approximately one half of the penile urethra has been sutured to skin. The remainder of the penis is amputated and the subcutaneous tissue and skin are closed routinely. Fine ophthalmic instruments make tissue handling and suturing easier. Use of a 2X magnifying loupe and headlamp light source enhances visualization of the urethral mucosa and facilitates accurate suturing. It is critical for the surgeon to recognize the glistening urethral mucosa and carefully suture it to skin. This will decrease (or eliminate) the chance of urethral stricture.

Perineal urethrostomy; dorsal approach

Perineal urethrostomy can be performed with the patient placed in dorsal recumbancy. This positioning is more ergonomic for the surgeon and allows easy access of the urinary bladder for concurrent cystotomy. When positioning the cat tie the hind limbs cranially until the pelvis is slightly elevated off the surgery table. Place a folded towel under the pelvis to support this slightly elevated position. The surgical technique is as described above for the perineal urethrostomy performed using a perineal approach.

Postoperative care and assessment

Perineal Urethrostomy: 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. An indwelling urinary catheter placed routinely postoperatively is NOT necessary following an uncomplicated urethrostomy.

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 urethrostomy have an 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 evaluation of calculus composition, dietary management, management of urinary tract infection, and attention to urine pH.

Patients that have an elective perineal 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 too large to pass through the urethrostomy stoma.
Principles of GI Surgery
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Key Points
- intestinal sutures should engage at least 3 - 4 mm beyond the cut edge of serosa and placed
  - no further apart than 2 mm
- always handle bowel wall with atraumatic technique
- examine the integrity of your anastomosis visually
- 50 - 60% of the small intestine of cats can be resected

Enterotomy
An enterotomy incision may be necessary for removal of intraluminal intestinal foreign bodies (e.g., balls, rocks, toys, linear foreign bodies), intestinal biopsy and exploration of the bile duct papilla or intestinal lumen. The segment of bowel to be incised should be removed from the abdominal cavity and packed off with moistened laparotomy pads. An incision parallel to the long axis of the bowel (i.e., longitudinal) or perpendicular to the long axis of the bowel (i.e., transverse) may be made on the antimesenteric border, preferably in healthy bowel (i.e., the aboral side of the foreign body). Closure is performed using appositional techniques (i.e., simple continuous or simple interrupted). Omentum can be placed over the enterotomy, but need not be sutured.

Transverse closure
If a large full thickness piece of intestine must be excised (i.e., mural mass, full thickness biopsy, etc) longitudinal closure may result in stenosis. To prevent this, transverse closure of the linear incision is recommended. This ensures adequate lumen diameter without the need for intestinal anastomosis. However, this technique is only recommended if a piece of intestine must be removed.

Intestinal anastomosis
Intestinal anastomosis is indicated for resection of nonreducible intussusception, necrotic bowel wall secondary to complete intestinal obstruction, intestinal volvulus, stricture secondary to trauma, linear foreign body with multiple perforations, and intestinal neoplasia (e.g., leiomyoma, leiomyosarcoma, adenocarcinoma).

After a complete abdominal exploration, the affected length of bowel is delivered from the peritoneal cavity and isolated with the use of moistened laparotomy pads and crib towels. If possible, the intestinal anastomosis should be performed on a water resistant surface (e.g., plastic drape, crib towel) to prevent ‘strike’ through contamination.

Once the level of resection has been determined, the appropriate mesenteric vessels are identified and ligated, and the portion of intestine to be resected is isolated by clamping the bowel at a 60° angle away from the mesenteric border. This angle ensures adequate blood supply to the antimesenteric border.

Everted mucosa
Occasionally when the segment of intestine to be removed is amputated mucosa ‘everts’ from the cut edge of the intestinal wall making it difficult to visualize the cut edge of the serosa. If this occurs it is ‘highly’ recommended to excise the everted mucosa to enable the surgeon to easily visualize the cut edge of the intestinal serosa. It is vital that the surgeon engage at least 3 – 4 mm of intestinal wall (measured from the cut edge of serosa) with each suture to guarantee adequate bites in the collagen laden submucosa.

Bowel lumen diameters
In cases where the oral end of the bowel is dilated and the aboral end is normal size, several options exist to create intestinal lumens of equal diameter:
1. Increase the angle of resection on the smaller diameter segment of bowel (i.e., aboral segment). This will increase the orifice size by 5-10 mm depending upon bowel diameter (e.g., dog vs cat).
2. In larger lumen size discrepancies the antimesenteric border of the smaller diameter stoma can be incised longitudinally to enlarge the lumen diameter.
3. An end-to-side anastomosis can be performed by closing the larger diameter stoma of the intestinal resection with a single layer continuous apposing suture pattern then anastomosing the smaller diameter segment of bowel to an appropriate size enterotomy made in the antimesenteric border of the larger diameter segment of bowel.
4. The larger diameter segment of bowel can be made smaller in diameter by suturing its cut edge until its lumen is equal in size to the smaller diameter intestine.

Intestinal anastomosis technique
See the DVD for a detailed video description of this technique (www.videovet.org).

When suturing an anastomosis, atraumatic handling of bowel wall and perfect anatomic apposition of incised margins is important. It is recommended to begin suturing at the mesenteric border as this allows adequate visualization of mesenteric vessels and helps
prevent encircling these vessels when placing each suture. Any of the appositional suture patterns previously described (i.e., simple continuous or interrupted) will result in a high success rate, both in the short-term (i.e., leakage, breakdown) and long-term (i.e., stricture, stenosis).

The following tips may prove helpful when performing an intestinal anastomosis (see the anastomosis video clip for detailed description of tips below):
1. First, place a stay suture to hold the mesenteric border of each segment of bowel in apposition. Tie this suture, leave the ends long, and place a hemostat on the suture end end without the needle.
2. Place a second stay suture to hold the antimesenteric border of each segment of bowel and bring the ends of the intestinal segments into apposition. Place a hemostat on the ends of this suture.
3. Place gentle traction on the mesenteric and antimesenteric stay sutures to bring the two intestinal segments into apposition.
4. Using the needle segment of suture from the mesenteric stay suture, begin a simple continuous appositional anastomosis being careful to get a 3 mm bite in the submucosa and placing each suture no more than 2 - 3 mm apart (2 mm apart in cats). When the anastomosis is complete, tie the suture to the mesenteric stay suture.
5. If a simple interrupted apposing suture pattern is used, be careful to get a 3 mm bite in the submucosa and place each suture no more than 2 - 3 mm apart.

The author’s preference for evaluating the integrity of anastomotic closure is to visually examine each suture to be certain that suture placement is no more than 2 - 3 mm apart and that each suture has a 3 to 4 mm bite.

Postoperative care
Intravenous fluids to maintain hydration and ensure renal function are continued postoperatively, until the patient begins to eat and drink. Intravenous fluids should then be tapered over a 24 to 48 hour period. Systemic antibiotics are continued postoperatively for 5-7 days; 10 - 14 days in cases with peritonitis and/or sepsis.

Feeding
Early return to enteral feeding is best for the overall health of the intesting. Feeding the postoperative gastrointestinal surgical patient is generally based on the following criteria:

a. preoperative condition of the patient
b. the condition of the bowel at the time of surgery
c. surgical procedure performed (i.e., enterotomy, anastomosis, pylorectomy)
d. presence or absence of peritonitis
e. postoperative condition of the patient.

The earlier patients can be returned to oral alimentation the better.

Complications
The most common postoperative complication of small intestinal surgery is leakage; leak is either associated with breakdown of the anastomosis or improper surgical technique (i.e., improper suture placement, inappropriate suture material, knot failure, sutures to far apart, inappropriate bite in the collagen laden submucosal layer, suturing nonviable bowel).

A presumptive diagnosis may be accomplished by the following:
1. Body temperature (may be up if acute or down if moribund).
2. Abdominal palpation: periodic, gentle abdominal palpation for pain (gas or fluid?).
3. General attitude (depression-anorexia).
4. Incision: examination of the patients incision for drainage (look at cytology if drainage is present)
5. CBC: leukocytosis followed by leukopenia (sepsis), or a degenerative left shift may imply breakdown.
6. Glucose: low glucose generally implies sepsis (this occurs early in sepsis and may be used as a screening test).
7. Abdominal radiographs: generally not helpful, they are difficult to critically assess due to the presence of postoperative air and lavage fluid. It can take 1 - 3 weeks for peritoneal air to diffuse from the abdominal cavity after routine abdominal surgery. Time variation is dependant upon the amount of air remaining in the abdominal cavity postoperatively (i.e., large deep chested animal vs a small obese animal).
8. Abdominal tap (paracentesis): a four quadrant abdominal tap is accomplished by aspirating fluid using a 5cc syringe and 20 gauge needle or placing a plastic IV catheter into the peritoneal cavity and allowing fluid to drip onto a slide.
9. Peritoneal lavage (if paracentesis is not productive): infuse 10-20cc/kg of sterile physiologic saline solution into the abdominal cavity, then gently palpate the abdomen and repeat the four quadrant paracentesis. This technique increases the sensitivity of paracentesis to 90%.

Once fluid has been obtained, a smear should be stained and evaluated microscopically. Depending upon the cell types seen, a determination of the presence of leakage can be made. Below are examples of expected cytology in patients with and without leak.
1. Healthy PMNs with few degenerate PMNs and a moderate number of red blood cells: This cytology may be expected in any postoperative abdominal procedure (e.g., OHE, abdominal exploratory, cystotomy). Your index of suspicion for anastomotic breakdown should be low. However, if clinical signs continue to deteriorate, repeat paracentesis (2 - 3 times daily, if necessary) to determine the “trend” of the abdominal fluid cytology is recommended.

2. Healthy polymorphonuclear leukocytes with bacteria located intra or extracellularly, degenerate PMNs with intracellular bacteria, free bacteria, or food particles--imply breakdown. Exploratory laparotomy is indicated.

In a recent morbidity/mortality study of patients undergoing intestinal surgery it was found that animals requiring a second abdominal surgery to treat intestinal disorders were less likely to survive than patients requiring only one laparotomy. Also, the longer it took to determine whether or not intestinal leakage had occurred the less likely the patient would survive reoperation. The take home message is: pay attention to detail during the first surgery and if you suspect a leak, early diagnosis will result in a better outcome.

**Prognosis**

The overall prognosis for uncomplicated GI surgery is excellent. The surgeon must pay attention to detail when suturing any hollow viscus organ.
Surgical Management of Cystic and Urethral Calculi in Cats
Howard Seim III, DVM, DACVS
Colorado State University
Fort Collins, CO

Key points
• Patients with cystic and 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

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

Definition
Cystic and urethral calculi have various compositions (i.e., oxalate, struvite, urate) 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, sex or breed predisposition.

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, blood tinged urine in the litter pan, 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 seen in the litter pan, 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
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/or crystalluria. Patients presenting after several days of complete obstruction may have significant changes in their biochemical profile including increased BUN, increased creatinine, metabolic acidosis, and severe electrolyte abnormalities. Urine is generally grossly hemorrhagic and urinalysis may show signs of urinary tract infection and crystalluria.

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. Careful radiographic evaluation of the kidneys and ureters should be done to rule out renal and ureteral calculi.

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 long enough to cause azotemia, temporary urinary diversion is provided by 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.
Urethral catheterization of a female cat
- Female urethral catheterization is easier than male
- Use a closed ended tom cat catheter
- Ventral recumbancy is recommended
- Pass the catheter with no evidence of resistance

Urethral catheterization – Female

Indications
Urethral catheterization is indicated in patients with urethral calculi (aids in retropulsion), measuring urinary output, chronic decompression of the urinary bladder, performing contrast cystography and preoperative placement to prevent cystic calculi from lodging in the urethra during cystotomy.

Applied anatomy
The urethra leaves the bladder at the neck and courses caudally. The female urethra is short, straight, and wide, passing directly to the vestibule. Urinary catheterization of female cats is relatively easy because of the anatomic characteristics mentioned above.

Anesthesia
Heavy sedation or preferably, general anesthesia, is recommended for predictably successful catheterization of the female urethra. Occasionally, unsedated, unanesthetized cats will tolerate the procedure if they are slightly depressed.

Technique

Positioning
The cat is placed in either lateral recumbency or ventral recumbency with the hindquarters elevated on a rolled fleece. Regardless of position chosen, it is important to maintain positional symmetry during the procedure. This author prefers ventral recumbency. The patient is placed on the rolled fleece with the hind legs hanging over the fleece, abducted slightly, and the tail held or tied directly over the back.

Patient preparation
The long hairs around the vulva can be clipped to enhance visualization of the vulvar lips. Alcohol preparation of the vulvar lips is performed prior to catheterization. The vaginal vault can be lavaged with a 1:50 dilution of 1% betadine solution and saline.

Catheters
A closed ended polyethylene tomcat catheter or a 3-1/2 French diameter feeding tube is recommended for urethral catheterization of female cats. Open-ended tomcat catheters may be used but may be more traumatic to the urethra during placement.

Catheter placement
The catheter is removed from the sterile packaging taking special care to maintain sterility during placement. Sterile K-Y jelly lubricant is generously placed on the tip and shaft of the catheter. Closed ended polyethylene tomcat catheters have a gentle curve when they are removed from their original sterile package. This curve is used to help ‘aim’ the catheter into the urethral papilla during placement.

With the catheter in the right hand, use the left index and middle finger to gently spread the vulvar lips. With the curve of the catheter pointing toward the floor, pass the tip of the catheter along the ventral midline of the vaginal vault and vestibule, taking care not to allow the catheter tip to enter the clitorin fossa. Gently pass the catheter in a cranial direction until the catheter can be felt to ‘fall’ into the urethral papilla. If any resistance is met during attempted placement, pull the catheter caudally into the vaginal vault, re-direct the catheter to the ventral midline of the vagina and re-insert the catheter. Once the catheter is felt to ‘fall’ into the urethra, pass the catheter into the urinary bladder until urine begins to drip from the catheter, ensuring proper placement.

Securing the catheter
If the catheter is to be maintained for an extended period of time select a soft 3.5 French diameter catheter and secure it to the vulva using a Chinese finger-trap friction suture technique. Attach the catheter to a closed collection device to maintain asepsis.

Catheter removal
Cut the Chinese finger-trap friction suture and gently pull the catheter. Hematuria may be seen for 12 – 24 hours after catheter removal.

Retrograde hydropulsion of lodged urethral calculi

Calculus removal
Retrograde hydropulsion: This technique should result in an 80-85% success rate for retropulsing urethral calculi into the urinary bladder!

Thoroughly mix 20 cc of sterile saline and 5 cc of Surgilube or K-Y Jelly in a 35 cc syringe and attach the syringe to a 3.5 - 5.0 French soft rubber catheter/feeding tube.

Anesthetize the patient, 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.
Using a back and forth action on the catheter, simultaneously inject the saline/lubricant mix under extreme pressure.

a) 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.
b) This technique is attempted, and generally successful, regardless of how many stones are in the urethra and no matter where they are lodged.

If the above technique fails, use a stiffer catheter (i.e., open or closed ended tomcat catheter) and repeat the above maneuvers. Use care when manipulating these stiffer catheters against the calculus.

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 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 feline 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 blood filled corpus cavernosum urethra 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, cystostomy tube placement and routine cystotomy.

Urethrostomy
Urethrostomy is generally performed in patients that are recurrent stone formers. It provides a permanent opening that is large enough to accommodate passage of most urethral calculi, crystals and mucoid debris.

Perineal urethrostomy; perineal approach
The perineal urethra is the location of choice for urethrostomy in cats. It is a convenient location for surgical manipulation, the urethral diameter will accommodate passage of most urethral calculi and there is less urine scald postoperatively.

Prior to surgery a urethral catheter is passed, if possible. After a routine castration, an elliptical incision is made around the scrotum and penis. Then the subcutaneous tissues are dissected to expose penile urethra. The penile urethra is dissected free from surrounding connective tissue. The ventral attachment of the pelvic urethral to the pubis (i.e., ishiocavernous m.) is identified and transected. The penile urethra is freed from its connective tissue attachments to the pelvic floor using blunt digital dissection. The retractor penis muscle is identified on the dorsal aspect of the penis and is dissected from its attachment on the penis. The dissected retractor penis muscle is then used to develop the dorsal plane of dissection to separate the pelvic urethra from its dorsal connective tissue attachments. Once the urethra is dissected enough to visualize the dorsolaterally located bulbourethral glands penile dissection can stop. The penis is catheterized and the urethral orifice identified. An incision is made from the penile urethra to the pelvic urethral to the level of the bulbourethral glands using a Stevens tenotomy scissor or Iris scissor. The urethral orifice at the level of the bulbourethral glands is generally of large enough diameter to accept the flange of a tomcat catheter.

After incision of the urethra, the glistening urethral mucosa is identified. 5-0 nonabsorbable monofilament suture with a swaged on cutting or taper-cut needle is recommended by the author. The first urethrostomy suture is placed at the dorsal aspect of the urethrotomy incision on the right or left side at a 45o angle to include urethral mucosa and skin (suture split thickness of skin). The suture is tied and cut leaving the ends 3-4 cm long to act as a stay suture. A mosquito hemostat is placed on this suture to provide traction and countertraction to enhance visualization of the urethral mucosa. The second suture is placed opposite the first suture and tied as described for the first. A stay suture is also placed here. A third urethrostomy suture is placed directly on the dorsal midline to hold the dorsal margin of urethral mucosa to the dorsal margin of the skin incision. Alternating sutures from dorsal to ventral are
placed until approximately one half of the penile urethra has been sutured to skin. The remainder of the penis is amputated and the subcutaneous tissue and skin are closed routinely. Fine ophthalmic instruments make tissue handling and suturing easier. Use of a 2X magnifying loupe and headlamp light source enhances visualization of the urethral mucosa and facilitates accurate suturing. It is critical for the surgeon to recognize the glistening urethral mucosa and carefully suture it to skin. This will decrease (or eliminate) the chance of urethral stricture.

**Perineal urethrostomy:** dorsal approach

Perineal urethrostomy can be performed with the patient placed in dorsal recumbancy. This positioning is more ergonomic for the surgeon and allows easy access of the urinary bladder for concurrent cystotomy. When positioning the cat tie the hind limbs cranially until the pelvis is slightly elevated off the surgery table. Place a folded towel under the pelvis to support this slightly elevated position. The surgical technique is as described above for

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**Perineal approach:** is the location of choice for urethrostomy in cats. It is a convenient location for surgical manipulation, the urethral diameter will accommodate passage of most urethral calculi and there is less urine scald postoperatively.

- See the DVD for a detailed video description of the surgical procedure. Prior to surgery a urethral catheter is passed, if possible. After a routine castration, an elliptical incision is made around the scrotum and penis. Then the subcutaneous tissues are dissected to expose penile urethra. The penile urethra is dissected free from surrounding connective tissue. The ventral attachment of the pelvic urethral to the pubis (i.e., ishiocavernosus m.) is identified and transected. The penile urethra is freed from its connective tissue attachments to the pelvic floor using blunt digital dissection. The retractor penis muscle is identified on the dorsal aspect of the penis and dissection is performed from its attachment on the penis. The dissected retractor penis muscle is then used to develop the dorsal plane of dissection to separate the pelvic urethra from its dorsal connective tissue attachments. Once the urethra is dissected enough to visualize the dorsolaterally located bulbourethral glands penile dissection can stop. The penis is catheterized and the urethral orifice identified. An incision is made from the penile urethra to the pelvic urethral at the level of the bulbourethral glands using a Stevens tenotomy scissor or Iris scissor. The urethral orifice at the level of the bulbourethral glands is generally of large enough diameter to accept the flange of a tomat catheter.

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**Perineal urethrostomy:** dorsal approach

See the DVD for a detailed video description of this surgical procedure. Perineal urethrostomy can be performed with the patient placed in dorsal recumbancy. This positioning is more ergonomic for the surgeon and allows easy access of the urinary bladder for concurrent cystotomy. When positioning the cat on the operating table tie the hind limbs cranially until the pelvis is slightly elevated off the surgery table. Place a folded towel under the pelvis to support this slightly elevated position. The surgical technique is as described above for the perineal urethrostomy performed using a perineal approach.

**Cystotomy**

See the DVD for a detailed video description of this procedure. 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. 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. The patient is place in dorsal recumbancy with the hind legs tied gently cranially to slightly elevate the pelvis. A folded towel is placed under the pelvis to help support it in this position. This positioning will greatly facilitate exteriorizing the penis during surgery. Just prior to aseptic preparation of the abdomen a soft, 5-8 French red rubber catheter or feeding tube is placed into the prepuce and a prepucal lavage is performed using 20 cc of a 1:50 dilution of 1% betadine solution and sterile saline. This aseptically prepares the penis and prepuce so they can remain in the surgical field throughout the cystotomy procedure.
A caudal midline incision is made from umbilicus to pubis. 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 easy retrieval of all 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. 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 calculi are palpated further attempts are made to retrieve them. Once no more calculi can be spooned or palpated the indwelling urethral catheter placed after retreatment is removed.

Next, a 3.5 - 5 French urethral catheter is placed in the penile urethra (i.e., retrograde). A dry sponge is used to grasp the extruded penis to create a water tight seal around the catheter. A 35cc 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 high pressure lavages and negative results in obtaining stones, the catheter is placed from the bladder lumen into 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 (‘urogenital floss’) to ensure there are no remaining calculi (i.e., gritty feeling while passing the catheter).

Finally, a piece of bladder mucosa is excised from 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 loupe, ophthalmic instruments, 4-0 or 5-0 monofilament nonabsorbable 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.

- 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.

- Perineal Urethrostomy: 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. An indwelling urinary catheter placed routinely postoperatively is NOT necessary following an uncomplicated urethrostomy.

**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 urethrostomy have an 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 evaluation of calculus composition, dietary management, management of urinary tract infection, and attention to urine pH.

- Patients that have an elective perineal 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 too large to pass through the urethrostomy stoma.
Surgical Management of Penetrating Abdominal Trauma
Howard Seim III, DVM, DACVS
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Patients that sustain a traumatic injury severe enough to cause an abdominal hernia or patients that sustain penetrating abdominal wounds (i.e., gunshot, bite wounds) should have an exploratory laparotomy. After a review of general principles and techniques of abdominal surgery in cats, including the surgical techniques for ventral midline celiotomy, abdominal exploration, abdominal wall closure, and management of complications such as wound dehiscence, these proceedings outline the surgical management of traumatic abdominal wall hernias and peritonitis. Step by step descriptions of the surgical technique for repair of abdominal hernias are provided. For peritonitis, we will cover the indications and techniques for abdominocentesis, exploratory surgery, diagnostic abdominal lavage, and open abdominal drainage. In the lecture, case examples admitted to the author’s critical care service will be used to illustrate the surgeons' decision making techniques. Video of clinical case material will be used to illustrate all techniques.

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

Key facts
- The abdomen generally is explored by means of a ventral midline incision from xyphoid to pubis. In most animals the entire abdomen, including the inguinal areas and the caudal thorax, should be prepared for aseptic surgery to allow extension of the incision into the thoracic or pelvic cavities if necessary.
- Various techniques can be used to systematically explore the entire abdomen; every surgeon should develop a consistent pattern to ensure that the entire abdominal cavity and all structures are visualized and/or palpated in each animal.
- Complications of abdominal surgery, including dehiscence (incisional hernias), may occur if improper surgical technique is used. The most common cause of wound dehiscence in the early postoperative period results from the surgeon’s inability to recognize the rectus sheath or not getting adequate bites in the collagen dense rectus sheath.
- Patients that sustain a traumatic injury severe enough to cause an abdominal hernia or patients that sustain penetrating abdominal wounds (i.e., gunshot, bite wounds) should have a xyphoid to pubis abdominal exploratory laparotomy.
- For most abdominal hernias, perform a ventral midline abdominal incision to allow the entire abdomen to be explored. Assess the extent of visceral herniation. Reduce the herniated contents and amputate or excise necrotic or devitalized tissue around the hernia. Close the muscle layers of the hernia with simple interrupted or simple continuous sutures.
- Abdominocentesis—the percutaneous removal of fluid from the abdominal cavity—usually is done for diagnostic purposes although it may occasionally be therapeutic. Indications include shock without apparent cause, undiagnosed disease with signs involving the abdominal cavity, suspicion of postoperative gastrointestinal dehiscence, blunt or penetrating abdominal injuries (i.e., gunshot wounds, dog bites, vehicular injury), and undiagnosed abdominal pain.
- Exploratory surgery is indicated when the cause of peritonitis cannot be determined or when bowel rupture, intestinal obstruction (e.g., bowel incarceration, neoplasia), or mesenteric avulsion is suspected.
- Although the practice of routinely lavaging the abdominal cavity of animals is controversial, lavage is always indicated with diffuse peritonitis. Lavage should be done with care in animals with localized peritonitis to avoid dissemination of infection.

General principles and techniques
Definitions
Celiotomy is a surgical incision into the abdominal cavity. The term laparotomy often is used synonymously, although it technically refers to a flank incision. A sudden onset of clinical signs referable to the abdominal cavity (e.g., abdominal distention, pain, vomiting) is called an acute abdomen.

Surgical techniques
The abdomen generally is explored by means of a ventral midline incision from xyphoid to pubis. In most animals the entire abdomen, including the inguinal areas, and the caudal thorax should be prepared for aseptic surgery to allow extension of the incision into the thoracic or pelvic cavities if necessary.

Ventral midline celiotomy in cats
With the patient in dorsal recumbency, make a ventral midline skin incision beginning near the xiphoid process and extending caudally to the pubis. Sharply incise the subcutaneous tissues until the external fascia of the rectus abdominis muscle is exposed. Ligate or cauterize small subcutaneous bleeders and identify the linea alba. Tent the abdominal wall and make a sharp incision into the linea alba with a scalpel blade. Palpate the interior surface of the linea for adhesions. Use scissors to extend the incision cranially or caudally (or both) to near the extent of the skin incision. Digitally break down the attachments of one side of the falciform ligament to
the body wall or excise it and remove it entirely if it interferes with visualization of cranial abdominal structures. Clamp the cranial end of the falciform ligament and ligate or cauterize bleeders before removing it.

**Abdominal exploration**

Systematically explore the entire abdomen. Various techniques may be used; however, every surgeon should develop a consistent pattern to ensure that the entire abdominal cavity and all structures are visualized and/or palpated in each animal.

Use moistened laparotomy sponges to protect tissues from drying during the procedure. If generalized infection is present or if diffuse intraoperative contamination has occurred, flush the abdomen with copious amounts of warmed, sterile saline solution with no additives (i.e., antiseptics or antibiotics). Remove the lavage fluid and blood and inspect the abdominal cavity before closure to ensure that all foreign material and surgical equipment have been removed. Perform a sponge count and compare it with the preoperative count to ensure that surgical sponges have not been left in the abdominal cavity.

**Abdominal wall closure**

The linea alba may be closed with a simple continuous (author’s preference) or a simple interrupted suture pattern. The simple continuous technique does not increase the risk of dehiscence when properly performed (i.e., secure knots, appropriate suture material, adequate bites in the rectus sheath), and it allows for a rapid and more secure closure. Synthetic monofilament absorbable suture (Maxon, PDS) should be used for continuous suture patterns, and six to eight knots should be placed at each end of the incision line.

On each side of the incision, engage a 5 to 7 mm bite of white rectus sheath with each suture. Place sutures no further apart than 3 to 4 mm, depending on the animal’s size. Tighten sutures sufficiently to appose but not enough to strangulate tissue, because sutures that strangulate tissue negatively affect wound healing. Incorporate full thickness bites of the abdominal wall in the sutures if the incision is midline (i.e., through the linea alba). If the incision is lateral to the linea alba and muscular tissue is exposed (i.e., paramedian incision), close the external rectus sheath without including muscle or peritoneum in the sutures. Close subcutaneous tissues with a simple continuous pattern of absorbable suture material and reappose the preputialis muscle fibers in the male dog. Use nonabsorbable sutures (simple interrupted or continuous appositional pattern) or stainless steel staples to close skin. Place skin sutures without tension.

**Complications**

Dehiscence (incisional hernias) may occur if improper surgical technique is used (see the above discussion). The most common cause of wound dehiscence in the early postoperative period results from the surgeon’s inability to recognize the rectus sheath or not getting adequate bites in the rectus sheath. Bites should engage at least 5 to 7 mm or more depending upon patient size.

**Traumatic abdominal wall hernias**

**Definitions**

**External abdominal hernias** are defects in the external wall of the abdomen that allow protrusion of abdominal contents; **internal abdominal hernias** are those that occur through a ring of tissue confined within the abdomen or thorax (i.e., diaphragmatic hernia, hiatal hernia). External abdominal hernias may involve the abdominal wall anywhere other than the umbilicus, inguinal ring, femoral canal, or scrotum.

**Surgical treatment**

Patients that sustain a traumatic injury severe enough to cause an abdominal hernia or patients that sustain penetrating abdominal wounds (i.e., gunshot, bite wounds) should have a xiphoid to pubis abdominal exploratory laparotomy. All visceral structures should be carefully examined to signs of trauma (e.g., mesenteric rents, ruptured hollow viscous organs, avulsed kidney, ureteral damage). In addition, abdominal celiotomy approach facilitates abdominal hernia closure. Most abdominal hernias can be repaired by suturing torn muscle edges or apposing the disrupted abdominal wall edge to the pubis, ribs, or adjacent fascia. In rare cases synthetic mesh must be used to repair the defect. Some hernias (i.e., intestinal strangulation, urinary obstruction, concurrent organ trauma) require emergency surgical correction. The extent of devitalized muscle may not be apparent initially, however, for patients in stable condition, delaying surgery until muscle damage can be accurately assessed facilitates surgical correction. The most common complications of surgery are hernia recurrence and wound infection. Abdominal hernias that occur secondary to bite wounds usually are contaminated; wound infection and dehiscence of the skin or hernial repair (or both) may occur. Mesh should not be placed in these hernias, hernial closure is performed during exploratory laparotomy, and the skin wounds should be left open to drain. Treatment of infected wounds includes cultures, drainage, antibiotics, and/or flushing.

**Positioning**

For ventral hernias the animal is placed in dorsal recumbency and the area around the hernia is prepared for aseptic surgery. Repair of ruptures of the cranial pubic ligament may be facilitated by placing the animal in dorsal recumbency with the rear limbs flexed and pulled cranially.
**Surgical techniques**

**Abdominal hernias**

For most abdominal hernias, perform a ventral midline abdominal incision to allow the entire abdomen to be explored. Assess the extent of visceral herniation. Reduce the herniated contents and amputate or excise necrotic or devitalized tissue around the hernia. Close the muscle layers of the hernia with simple interrupted or simple continuous sutures.

**Cranial pubic ligament hernias**

Make a ventral midline skin incision and identify the ruptured tendon and its pubic insertion. Evaluate the inguinal rings and vascular lacuna; these hernias may extend into the femoral region as a result of rupture of the inguinal ligament. Reattach the free edge of the abdominal wall to the cranial pubic ligament with simple interrupted sutures. As an alternative, suture the tendon remnant to the muscle fascia and periosteum covering the pubis or anchor it to the pubis by drilling holes in the pubic bone through which sutures can be placed. If the hernia extends into the femoral region, it may be necessary to suture the body wall to the medial fascia of the adductor muscles. When doing so, take care to avoid damaging the femoral vessels or nerves.

**Prognosis**

The prognosis generally is good, and recurrence is uncommon. When recurrence occurs, it generally is noted within a few days of surgery. Most animals have excellent long-term results when appropriate techniques are used.

**Peritonitis**

**Definition**

**Primary generalized peritonitis** refers to spontaneous inflammation of the peritoneum without any pre-existing intra-abdominal pathologic condition. **Secondary generalized peritonitis** occurs in conjunction with an intra-abdominal pathologic condition and may be further classified as infectious or noninfectious.

**Surgical treatment**

**Abdominocentesis** (see below) is the percutaneous removal of fluid from the abdominal cavity, usually for diagnostic purposes, although it may occasionally be therapeutic. Indications include shock without apparent cause, undiagnosed disease with signs involving the abdominal cavity, suspicion of postoperative gastrointestinal dehiscence, blunt or penetrating abdominal injuries (i.e., gunshot wounds, dog bites, vehicular injury), and undiagnosed abdominal pain. A multifenestrated catheter should be used to enhance fluid collection. Physical and radiographic examinations should precede abdominocentesis to rule out instances in which it may not be safe and to guide needle placement. Four-quadrant paracentesis may be performed if simple abdominocentesis is not successful in retrieving fluid. It is similar to simple abdominocentesis except that multiple abdominal sites are assessed by dividing the abdomen into four quadrants through the umbilicus and tapping each of these four areas. Diagnostic peritoneal lavage should be performed in animals suspected of having peritonitis if the above methods are unsuccessful in obtaining fluid for analysis.

Exploratory surgery is indicated when the cause of peritonitis cannot be determined or when bowel rupture, intestinal obstruction (e.g., bowel incarceration, neoplasia), or mesenteric avulsion is suspected. Serosal patching and plication reduce the incidence of intestinal leakage, dehiscence, or repeated intussusception. Animals that require surgery and that have peritonitis secondary to intestinal trauma (disruption of mesenteric blood supply, bowel perforation, chronic intussusception, foreign body) often are hypoproteinemic. The role that protein levels play in healing intestinal incisions is not well understood. However, most surgeons are concerned that hypoproteinemic patients may not heal as quickly as patients with normal protein levels, despite one study that showed similar complication rates among animals with normal protein levels and those that were hypoproteinemic and undergoing intestinal surgery. Most experimental evidence has shown that retardation of wound healing is not seen with moderate protein depletion but only with severe deficiencies (<1.5 to 2 g/dL).

Although the practice of lavaging the abdominal cavity of animals with peritonitis is controversial, lavage generally is indicated with diffuse peritonitis. Lavage should be done with care in animals with localized peritonitis to avoid dissemination of infection. When lavage is performed, as much of the fluid as possible should be removed because fluid inhibits the body’s ability to fight off infection, probably by inhibiting neutrophil function. Historically, many different agents have been added to lavage fluids, especially antiseptics and antibiotics. Povidone-iodine is the most widely added antiseptic; however, its use may be contraindicated with established peritonitis. Furthermore, no beneficial effect of this agent has been shown in repeated experimental and clinical trials in animals. Although a great many antibiotics have been added to lavage fluids over the years, there is no substantial evidence that their addition is of any benefit to patients who are being treated with appropriate systemic antibiotics. Warmed sterile physiologic saline is the most appropriate lavage fluid.

**Positioning**

For abdominocentesis and diagnostic lavage, the abdomen should be clipped and prepared aseptically. These procedures may be performed with the animal in lateral recumbency or standing.

**Abdominocentesis**

Insert an 20- or 22-gauge, 1-inch plastic over-the-needle catheter (with added side holes) into the abdominal cavity at the most dependent part of the abdomen. Do not attach a syringe; instead allow the fluid to drip from the needle and collect in a sterile tube. If
sufficient fluid is obtained, place it in a clot tube and an ethylenediamine tetraacetic acid (EDTA) tube, submit samples for aerobic and anaerobic culture, and make four to six smears for analysis. If fluid is not obtained, apply gentle suction using a 3-mL syringe.

It is difficult to puncture bowel by this method because mobile loops of bowel move away from the tip of the needle as it strikes them. Perforations created by a needle this size usually heal without complications. The major disadvantage of needle paracentesis is that it is insensitive to the presence of the small volumes of intraperitoneal fluid and thus a negative result can be meaningless. At least 5 to 6 mL of fluid per kilogram of body weight must be present in the abdominal cavity of dogs to obtain positive results in most cases using this technique.

**Diagnostic peritoneal lavage**

Make a 2-cm skin incision just caudal to the umbilicus and ligate any bleeders to avoid false-positive results. Spread loose subcutaneous tissues and make a small incision in the linea alba. Hold the edges of the incision with forceps while the peritoneal lavage catheter (Stylocath) without the trocar is inserted into the abdominal cavity. Direct the catheter caudally into the pelvis. With the catheter in place, apply gentle suction. If blood or fluid cannot be aspirated, connect the catheter to a bottle of warm sterile saline and infuse 20 mL/kg of fluid into the abdominal cavity. When the calculated volume of fluid has been delivered, roll the patient gently from side to side, place the bottle on the floor, vent it, and collect the fluid by gravity drainage. Do not be surprised if you do not retrieve all of the fluid, particularly in dehydrated animals.

**Exploratory laparotomy**

Perform a ventral midline incision from the xiphoid process to the pubis. Obtain a sample of fluid for culture and analysis. Explore and inspect the entire abdomen. Find the source of infection and correct it. Break down adhesions that may hinder drainage. Lavage the abdomen with copious amounts of warm, sterile saline if the infection is generalized. Remove as much necrotic debris and fluid as possible. Close the abdomen routinely, place an abdominal drain, or perform open abdominal drainage.

**Prognosis**

The prognosis for animals with generalized peritonitis is guarded; however, with proper and aggressive therapy, many survive. Some authors have suggested that the mortality rate approaches 50%. The mortality rates reported in animals with generalized peritonitis treated with open abdominal drainage have varied from 20% to 48%.
Ruptured bladder
Trauma to the urinary bladder is relatively common in veterinary patients. It often results in uroperitoneum (uroabdomen) that is associated with severe metabolic and multisystemic disturbance which can be fatal if not treated urgently but appropriately.

Blunt abdominal trauma (vehicular is the most common cause) and direct injury from pelvic fractures are the most common reasons for injury to the bladder in dogs. In cats, blunt abdominal trauma, injury during catheterization and rupture during bladder palpation are the most common causes of urethral and bladder rupture. Other reasons include urethral obstruction, erosive neoplastic lesions, or penetrating abdominal wounds. The most common site of urinary tract trauma is the bladder. The apex is most often the site of rupture although any part of the bladder can be affected especially when pelvic fractures are the cause.

Patients with a ruptured bladder often do not show clinical signs immediately after injury. However over the subsequent 24–48 hours patients often become dehydrated and begin to develop metabolic and electrolyte disturbances that can become severe and life threatening. As urine accumulates in the peritoneal space a chemical peritonitis ensues which, if sterile, is not immediately life-threatening but causes abdominal pain and ileus. Urine is hyperosmolar to the extracellular fluid. This results in a net flux of fluid across the peritoneal membrane. Third-spacing of fluid in the peritoneal cavity along with decreased intake and often increased losses due to vomiting leads to severe dehydration. Hyperkalemia and azotemia develop as peritoneal potassium and urea equilibrate rapidly with extracellular fluid. Metabolic acidosis often develops due to decreased excretion of hydrogen ions in urine and progressively worsening hypovolemic shock.

Rapid diagnosis of urinary tract injury is vital. Aggressive emergency management of associated metabolic abnormalities to stabilize the patient should be performed prior to definitive surgical repair.

Diagnostic criteria
History
Gender predisposition: In cats there is no sex predisposition. Male dogs are predisposed to traumatic bladder rupture because the longer, less distensible male urethra is more able to withstand elevated intravesicular pressure. There are no known age or breed predispositions

Physical examination findings
Lethargy, anorexia, dehydration, abdominal pain, ascites, hypothermia, other signs of traumatic injury

Laboratory findings
Azotemia, hyperkalemia, metabolic acidosis, hyperalbuminemia, increased hematocrit, neutrophilia

Fluid analysis: Samples of abdominal fluid can be obtained by abdominocentesis or diagnostic peritoneal lavage.

Collection of Peritoneal Fluid Sample:
Abdominocentesis – this technique is successful in the majority or cases.
The patient is positioned in lateral recumbency
An area is clipped and aseptically scrubbed along the ventral midline approximately 10x10cm
Insert a 20 or 22 gauge 1½ inch needle on a 3 or 6ml syringe 1cm caudal to the umbilicus and just off the midline (avoiding the falciform ligament)
Aspirate gently and collect samples for fluid analysis, cytology and microbial culture and sensitivity testing
Multiple quadrant abdominal taps can be performed if the above is unsuccessful
If one site yields a fluid sample the other taps are abandoned.

The fluid recovered can be a transudate, modified transudate or exudate depending on the chronicity and whether concurrent sepsis is present. Comparison of creatinine and potassium concentrations in peritoneal fluid and serum are the most reliable tests for confirming uroabdomen in cats. Because of the large molecular size of creatinine it diffuses only slowly across the peritoneum into the extracellular fluid. A significant gradient is established between abdominal fluid and serum, detection of which is a sensitive and specific test for uroabdomen. A similar gradient exists with potassium. Patients with creatinine and potassium levels in their abdominal fluid that are slightly to markedly higher than in their serum are very likely to have a uroabdomen. Reported ratios of abdominal fluid to serum creatinine concentrations in cats is a mean of 2:1. The same ratio for potassium in cats is a mean of 1.9:1

Plain abdominal radiography: The bladder may or may not be visible in patients with bladder rupture as small leaks will still allow distension of the bladder to some degree. Loss of abdominal detail will occur due to fluid accumulation which will worsen with time. Evidence of an underlying cause may be obvious such as pelvic fractures or cystic or urethral calculi.

Contrast radiography: Care should be taken administering contrast agents to dehydrated or azotemic patients as renal insult can result. Patients should be fully stabilized before undergoing these studies. Positive contrast retrograde urethrocystography is the
contrast of choice in patients with bladder rupture and should be the first radiographic study performed. It is easy to perform and allows confirmation of the diagnosis and location of the site of leakage in the lower urinary tract in most cases. Fluoroscopic visualization during contrast injection is helpful as it aids in early detection of the site of leakage. If not available plain radiography can confirm leakage but dispersal of contrast material may obscure the origin of the leakage somewhat. If sufficient intravesical pressure is not achieved during contrast injection false negative results may be seen especially with small tears and in unusual cases where the lesion has self sealed. As leakage of urine from the upper urinary tract cannot be detected with a retrograde cystourethrogram an intravenous urogram should be performed especially if no lesions were found during the first study.

Abdominal ultrasonography: Ultrasound examination should detect fluid accumulation in the peritoneal space and can be used to guide abdominocentesis. It may also help identification of underlying bladder pathology, calculi and other possible causes of uroabdomen such as renal, ureteral and urethral lesions.

**Differential diagnoses**

Leakage or urine from a location other than the bladder can usually be ruled out with contrast studies of the upper and lower urinary tract such as a retrograde urethrocystogram and an intravenous urogram.

Other causes of acute abdomen can usually be ruled out by abdominocentesis, radiographic and/or ultrasonographic examination.

**Treatment recommendations**

The aim of initial treatment is pre-surgical patient stabilization. Principal areas of concern are azotemia, electrolyte and acid-base disorders, and cardiac arrhythmias that result from severe hyperkalemia.

Drainage of urine from the abdomen is the next most important step. This can be achieved with a percutaneous placement of a peritoneal lavage catheter (feeding tube, Jackson Pratt drain, etc). Use of an indwelling urethral catheter or tube cystostomy is helpful in decreasing the amount of urine entering the peritoneal space from the bladder.

Surgical management is ultimately required in most cases. However, uroabdomen is a medical and not a surgical emergency. Patients operated on prior to adequate stabilization are likely to experience life threatening intraoperative and post operative complications.

**Initial treatment**

Intravenous fluid therapy: Fluids should be administered upon admission. An isotonic saline solution (0.9% NaCl) is the fluid of choice. Volume of fluid given is judged by degree of hypovolemia and is made on a case by case basis.

Treatment of hyperkalemia: Mild hyperkalemia will often resolve with fluid diuresis alone. More severe hyperkalemia (> 7mEq/L) may be associated with cardiotoxicity and specific treatment should be considered.

Cardiac monitoring: Continuous ECG monitoring is recommended. Most cardiac abnormalities are related to hyperkalemia and will resolve once normokalemia is re-established. Typical changes are absent or flattened P waves, prolongation of the P-R interval, widened QRS complexes, spiked T waves and bradyarrythmias. ECG abnormalities however are not consistent and it should not be assumed that hyperkalemia is absent if the ECG is normal or vice versa.

Analgesia: Pain relief should be instituted early as chemical peritonitis is very painful. Opioid analgesics are most commonly used such as morphine, hydromorphone, or buprenorphine.

Antibiotics: Intravenous antibiotics should be instituted. A first generation cephalosporin such as Cefazolin is an appropriate empirical choice.

**Surgical management**

Exploratory Laparotomy: A xiphoid to pubis exploratory laparotomy is performed. Patients that present with a ruptured bladder have sustained enough trauma to result in concurrent visceral organ injury thus a complete abdominal exploratory is recommended. Any rents in the bladder are identified and the area debrided of necrotic or damaged tissue. The bladder is sutured with one layer simple continuous or simple interrupted suture pattern using a synthetic absorbable suture (such as 3-0 or 4-0, Capryson, Monocryl, Biosyn Dexon, Vicryl, Polysorb) in an appositional pattern. No attempt is made to invert the incision. Copious lavage of the peritoneal cavity is performed with body temperature sterile physiologic saline solution followed by routine abdominal closure. If bladder wall integrity is of concern post-operatively an indwelling urethral catheter can be left in place for 24-48 hours to allow decompression but is not mandatory.

**Supportive treatment**

Intravenous fluid therapy with an isotonic saline solution should be administered post-operatively depending on the patient’s hydration status. This should be maintained until the patient is drinking.

Antibiotic therapy: If the abdominal effusion was sterile it is not necessary to continue antibiotic therapy beyond the intraoperative period. However if septic effusion was detected antibiotic therapy based on the results of culture and sensitivity should be continued for at least two weeks.

Analgesia: Appropriate opioid analgesia should be continued post-operatively for at least 48 hours.

Gastric protectants: Uremic gastritis may cause vomiting and ulceration. Treatment with an H2 receptor antagonist or proton pump blocker should be considered.
**Patient monitoring**

Repeat serum biochemical analysis should be performed post-operatively to demonstrate resolution of azotemia, electrolyte imbalances and acid-base abnormalities.

Urinary leakage post-operatively is a potential complication and should be diagnosed promptly if present. Failure to recover from surgery uneventfully, persistence of azotemia or hyperkalemia and recurrence of abdominal distension should alert the clinician to a possible problem.

Continuous ECG monitoring should be performed until complete resolution of all cardiac abnormalities.

**Prognosis**

In general prognosis after bladder rupture is excellent if diagnosis and treatment are prompt.

**Favorable criteria**

Simple rents in the apex of the bladder are easy to close. In cases where bladder wall damage is extensive or in ruptures secondary to avascular necrosis of the bladder wall prognosis is less favorable.

Patients systemically stable prior to surgery that can be taken promptly to surgery are likely to make an excellent recovery.

**Unfavorable criteria**

- Surgical intervention prior to reversal of the patients metabolic derangement.
- Presence of septic peritoneal effusion.
- Significant delay in time to diagnosis and treatment may adversely affect outcome.
- Severe concurrent traumatic injuries.
Surgical Repair of Diaphragmatic Hernia
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Key points
- Most diaphragmatic hernias are not acutely life threatening
- Suture the hernia 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 heria 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 inflated alveoli 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 to the caval and the esophageal hiatus.

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 carmalts 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**

Postoperative 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.
The feline species may generally be considered to be a solitary creature where social interactions are concerned, but domestication has allowed the adaptation to living in social communities with both humans and other cats. Domestic cats are well known to be able to develop bonds with humans and other cats. The ability to socialize with other cats and humans will vary between individual cats as a function of their genetics, prenatal environment, early socialization and life experiences. Kittens that are handled by and interact with humans in their first few weeks of life are friendlier and less fearful of people. In contrast to this, some studies have suggested that hand-reared kittens tend to show more aggression. When available, understanding the cat’s socialization history may be beneficial in rooting out some of the underlying issues.

The causes of feline aggression towards humans can be multifold. These include play, territorial, fear and redirected aggression. Play aggression is a common concern amongst cat owners, and many times the predisposing factors can be identified through careful behavior questioning at kitten examination visits. Hand play is probably one of the most common concerns the author identifies when discussing play aggression with clients. Many kittens and cats showing play aggression towards their owners actively engage in hand play, with encouragement from the owner. Use of toys, not hands and feet, and the avoidance of any hand ‘wrestling’ will help to some play aggression concerns. During every kitten visit, appropriate play should be discussed, with a firm recommendation to avoid any hand/feet play. Kittens and cats are not able to distinguish degrees of acceptable behavior. If the client makes hand play acceptable, then the kitten, all body parts are ‘fair game’. Environmental enrichment and structured play times are beneficial in reducing play aggression.

Territorial aggression may be directed at new humans in the household, existing humans posing a threat to resources (this is rare) or may lead to redirected aggression where the human has become a new target during a territorial dispute. For example, cats may be anxious and feel territorial towards visible outdoor cats and turn this aggression inadvertently onto a human in the household.

Fear is a common reason for aggression towards humans. The cat may be fearful of the owner because of an incident that frightened the cat that was associated with the human in question. For example, a large item falling and crashing down causing a loud noise may have frightened the cat. The cat then associated the incident with the human that was nearby when the incident occurred. Unfortunately cats may experience abuse or aggressive treatment in their lifetime, either at the hands of a previous human or by the current owner. These experiences may leave the cat with a persistent fear against humans in general, the specific human causing the abuse, or humans with similar characteristics to the abuser (ex. men).

Redirected aggression is a complex problem that can occur for many reasons. The notable example is that described above under territorial aggression. In cases of redirected aggression, it can be doubly hard to identify the inciting cause or incident. These triggers must be identified, as avoiding them will be the mainstay to avoiding further episodes and increasing the chance of treatment success.

Behavioral questions should be a normal part of every feline visit from preventive care visits to sick cat visits to behavioral consultations. Clients will not always reveal their concerns unless asked. Even in cases where there are no concerns, the clinician might be able to identify potential triggers that may lead to future concerns (ex. hand play with kittens). When a client approaches the veterinary team for help with a behavioral problem, immediate and full support should be offered. The first step is to assess the cat or cats in question and ensure that no medical concerns exist. A full behavioral history should be obtained. The behavioral consultation can be conducted in clinic, or at the client household. The latter is a more favorable option, as it allows the clinician to directly observe the layout of the home and where incident(s) occur(red). It also allows the clinician to assess the environmental enrichment and determine the availability of appropriate resources.

**Goals for the behavioral interview and development of a treatment plan**

1. Identify underlying motivation for the behavior
2. Identify triggers and formulate a plan on how to avoid these
4. Develop a treatment plan

**Questions to ask during the behavioral interview**

Basic information should be gathered about the patient signalment, household members (people and animals), patient medical history and how/where the pet was acquired. The environment should be reviewed, including resource management and availability, litter box care, and household enrichment. The patient’s daily activities should be reviewed and in cases of house calls, traced throughout the house layout. Relationships with other pets in the house and with humans in the household should be reviewed. The stability of the human population should be assessed. For example, humans that work shift work hours may be home inconsistently, causing the
patient’s environment to be inconsistent. Family children that attend college or university may come and go every 4 months, creating an unstable social circle.

The incident considered the initiating incident, as well as further incidents should be reviewed in detail. There should be an examination of the frequency, intensity and severity of the behavior(s) in question. The behavior of both the cat and the response by the human should be determined. Any attempts at treatment or punishment should be reviewed as these may negatively impact the prognosis.

Points to consider with regards to the potential success of treatment
Cases of aggression towards humans can be devastating to the human animal bond. A frank, open discussion is necessary with the client(s) in order to determine the prognosis for the patient. It is important to determine how weakened or broken the human-animal bond has become as a result of the behavioral issues. The clinician will need a frank admission by the client about how willing they are to implement the outlined treatment plan. The clients will need to be open about what options they are considering. Options may include following the prescribed treatment plan, drugs, relinquishment and/or euthanasia. Further, the clients’ expectations must be known. What are the clients’ goals and timeline? The clients may have unrealistic expectations, desiring complete resolution of the problem.

Prognosis
The ability to resolve a human-directed aggression is going to depend on many factors. First and foremost, it is going to depend on the points noted above, as to what client expectations are and whether they are willing to follow prescribed treatment plans. If this is not the case, then the chances of success diminish greatly. Secondly, the duration of the problem, and third, its severity, will impact the chance to implement change. Cats showing aggression towards a specific human may never achieve complete resolution of their issues, and a life long alteration of the household dynamics, as well as lifelong medications may become a necessity. Setting realistic expectations and realistic time frames for achieving goals early on in the consultation process is more likely to set the stage for success or at least partial resolution. Clients and clinicians should understand the limitations of the problem and what is reasonable to expect from treatment.

Sample questionnaire for a home behavior consultation
Patient ID:
Patient Signalment:
  Medical conditions
  1. 
  2. 
  3.
  Current medications
  1. 
  2. 
  3.
  What amount of day does cat spend in the following activities?
  Sleeping
  Resting
  Eating
  Grooming
  Hiding
  Playing Alone
  Playing with human
  How often does cat use litter box for BM? U?
  Other pets?
  If Yes, details:
  Environment
  Layout- rough drawings attached
  Litter boxes
  Number
  Location
  Characteristics
  Feeding stations
  Number
  Location
  Characteristics
Feeding schedule
Food
Amount
Timing
  Private locations/Hidey spots
Number
Location
Used?
  Elevated locations/3D space availability
Location
Used?
  Windows
Location
Look out onto:
  Other environmental enrichment
  Humans in household
Number
Stability of residence
Stability of employment hours:
Relationship with Cat:
Other regular visitors:
  Potential external stressors noted outdoors
Unique considerations (ex. flooring type, smoking, cleanliness, clutter, noise levels
  Specific incidents reported
Known Triggers of Aggression:
Aggression directed towards:
Client/Individual reaction to aggressive behavior:
Any punishments used?
Yelling, swatting, other
Veterinarian Interactions with Cat during visit:

References
Chronic renal disease & IRIS staging

Decline in kidney function can result from a variety of causes including pyelonephritis, amyloidosis, polycystic kidney disease, neoplasia, nephrotoxicosis, hydronephrosis and chronic glomerulonephritis (Scherk, 2011). Although acute insult can lead to chronic kidney disease (CKD), age seems to be the only major, consistent risk factor associated with chronic renal insufficiency (White, 2011).

Mature cat visits ideally include a complete physical examination/consultation as well as data collection in the form of a minimum database (MDB) every 4 to 6 months. A minimum database for mature cats includes a full clinical chemistry, a total thyroid test (TT4), a complete blood count, a urinalysis and a blood pressure (BP) series. Blood urea nitrogen (BUN) and creatinine have traditionally been the go-to serum values for diagnosis of kidney disease. Early diagnosis can be challenging utilizing only these values, as azotemia does not develop until there is 75% loss of nephron function. The BUN can be influenced by factors other than renal disease, including dehydration, dietary protein content, gastrointestinal bleeding and hepatic insufficiency. Creatinine is a more reliable indicator of glomerular filtration rate (GFR). However, creatinine can be influenced by muscle wasting and by dehydration. Routine screening of these values can assist the clinician in documenting upward trends in these values.

Symmetrical dimethylarginine (SDMA) measures the methylated form of the amino acid arginine. This is a by-product of protein degradation excreted by the kidneys. SDMA increases with about 40% loss of kidney function. It can be impacted by dehydration. Symmetrical dimethylarginine is not a stand-alone test and should always be interpreted in light of patient status as well as other laboratory findings. Elevated SDMA in the absence of any other evidence of renal disease should be re-evaluated.

### Table 1 Urine specific gravity varies with age & diet (Scherk, 2011)

<table>
<thead>
<tr>
<th>Age or condition</th>
<th>Expected USG</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-8 weeks of age</td>
<td>1.020-1.038</td>
<td></td>
</tr>
<tr>
<td>8+ weeks of age</td>
<td>Up to 1.080</td>
<td>Denotes age at which full concentrating ability is reached</td>
</tr>
<tr>
<td>Dehydrates/normal renal function</td>
<td>&gt;1.040</td>
<td>Diet dependent (wet vs dry)</td>
</tr>
<tr>
<td>Canned food only</td>
<td>&gt;1.025</td>
<td></td>
</tr>
<tr>
<td>Dry food only</td>
<td>&gt;1.035</td>
<td></td>
</tr>
<tr>
<td>Inability to concentrate urine</td>
<td>1.008-1.012</td>
<td>Nephrons no longer able to modify glomerular filtrate</td>
</tr>
<tr>
<td>Dehydrated/unknown renal function</td>
<td>1.007-1.039</td>
<td>Suggestive of renal insufficiency with or without azotemia</td>
</tr>
</tbody>
</table>

It is recommended that urine samples be collected by cystocentesis and tested immediately in the clinic laboratory. Urine testing should include chemistry testing using testing strips, measurement of urine specific gravity (USG) by refractometer and sediment analysis. Urine specific gravity can be impacted by age, diet and hydration status. Urine specific gravity varies throughout the day, such that a single low USG is not reliable evidence of a loss of concentrating ability (Scherk, 2011). Samples with a low urine specific gravity (USG; less than 1.035) should be submitted for culture.

**International renal interest society (IRIS)**

For cats that are diagnosed with CKD, it is critical for practitioners to develop and promote a relationship with clients that will allow continued monitoring of the disease, including disease staging. The application of human IRIS staging guidelines to the study of feline renal disease has dramatically advanced our ability to tailor our patient therapy, thereby improving quantity and quality of life. In addition to the MDB as discussed above, imaging is likely to be beneficial.

### Table 2. IRIS staging guidelines

<table>
<thead>
<tr>
<th>Stage</th>
<th>Renal Azotemia</th>
<th>Creatinine</th>
<th>Clinical signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Non-azotemic</td>
<td>&lt;140 µmol/L</td>
<td>Absent</td>
</tr>
<tr>
<td>2</td>
<td>Mild</td>
<td>140-249 µmol/L</td>
<td>Mild or absent</td>
</tr>
<tr>
<td>3</td>
<td>Moderate</td>
<td>250-439 µmol/L</td>
<td>Moderate</td>
</tr>
<tr>
<td>4</td>
<td>Severe</td>
<td>&gt;440 µmol/L</td>
<td>Severe</td>
</tr>
</tbody>
</table>

Adapted from AAFP 2015 Dru Forrester, DVM, MS, DACVIM & Jane Robertson, DVM, DACVIM *Chronic Kidney Disease: Making the most of early diagnosis*
Table 3. Subclassifications of IRIS staging: Proteinuria

<table>
<thead>
<tr>
<th>Urine Protein:Creatinine Ratio (UPC)</th>
<th>Substage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.2</td>
<td>Non-proteinuric (NP)</td>
</tr>
<tr>
<td>0.2-0.4</td>
<td>Borderline proteinuric (BP)</td>
</tr>
<tr>
<td>&gt;0.4</td>
<td>Proteinuric (P)</td>
</tr>
</tbody>
</table>

Taken from AAFP 2015 Dru Forrester, DVM, MS, DACVIM & Jane Robertson, DVM, DACVIM  Chronic Kidney Disease: Making the most of early diagnosis

Table 4. Subclassifications of IRIS staging: Blood pressure

<table>
<thead>
<tr>
<th>Systolic BP (mmHg)</th>
<th>Diastolic BP (mmHg)</th>
<th>Substage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;150</td>
<td>&lt;95</td>
<td>Minimal risk (N)</td>
</tr>
<tr>
<td>150-159</td>
<td>95-99</td>
<td>Low Risk (L)</td>
</tr>
<tr>
<td>160-179</td>
<td>100-119</td>
<td>Moderate Risk (M)</td>
</tr>
<tr>
<td>&gt;180</td>
<td>&gt;120</td>
<td>High Risk (H)</td>
</tr>
</tbody>
</table>

Taken from AAFP 2015 Dru Forrester, DVM, MS, DACVIM & Jane Robertson, DVM, DACVIM  Chronic Kidney Disease: Making the most of early diagnosis

True proteinuria in cats is a known marker of poor prognosis in renal disease (Syme, H.M. et al, 2006; Syme, H.M., 2009). If proteinuria is established on the chemistry stick in the absence of active sediment, the sample will need to be submitted for a urine protein creatinine ratio (UPCR). The result should be used to direct therapy with medications to reduce the loss of protein into the urine. Ratios over 0.4 are significant and therapy is needed. If there is active sediment in the presence of proteinuria on the chemistry stick, and the UPCR is very high (>0.5), then the value may be significant and therapy may be indicated.

Blood pressure changes can be impacted by and/or impact the renal state of health (Brown, 2011). Sixty-five to 100% of cats with hypertension have evidence of reduced renal function (Jepson, 2011). The gold standard for blood pressure assessment in any species is central venous catheter assessment. Blood pressures can be measured non-invasively either by Doppler or oscillometric methods. Patient stress can be a limiting factor. Proper use of pain management in advance, as well as following cat friendly practice and handling guidelines will significantly reduce stress.

References

Robertson, Sheliah A., and Lascelles, B. Duncan X. Long-Term Pain in Cats: How Much Do We Know about This Important Welfare Issue? Journal of Feline Medicine and Surgery 2010 12; 188
Feline Chronic Kidney Disease: Sound Therapeutic Goals

Kelly St. Denis, DVM, DABVP
Charing Cross Cat Clinic
Brantford, ON

With the utilization of IRIS staging, the clinician gains significant ground in combatting chronic renal disease in cats. The data collected for the purpose of IRIS staging allows a tailored, individual approach to patient therapy. Although the clinician will have a wide range of therapeutics available to improve quality and quantity of life in the CKD patient, the client and patient relationship must always be considered. In particular, the clinician should consider the client’s ability and willingness to medicate the patient with multiple drugs multiple times a day. Available and necessary therapeutics may need to be prioritized in order to maintain client quality of life and the client-patient relationship.

Table 5: Survival time by IRIS stage

<table>
<thead>
<tr>
<th>IRIS Stage</th>
<th>2b*</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median Survival (days)</td>
<td>1151</td>
<td>778</td>
<td>103</td>
</tr>
<tr>
<td>Range (days)</td>
<td>2-3107</td>
<td>22-2100</td>
<td>1-1920</td>
</tr>
</tbody>
</table>

*2b Creatinine of 203-249 µmol/L

Taken from AAFP 2015 Dru Forrester, DVM, MS, DACVIM & Jane Robertson, DVM, DACVIM  Chronic Kidney Disease: Making the most of early diagnosis

Treatment for pain is essential. Medications such as gabapentin should be prescribed at a dosage of 15-20 mg/kg PO q12h. In debilitated cats, a dosage of 5-10 mg/kg POq12h is the initial chosen dosage. This medication is safe for use in all diseased states and the only initial side effect is sedation. After 1-2 weeks, any sedation will wear off and the cat will continue to be more comfortable. The dosage will need to be titrated up and down in order to meet the particular patient’s needs. Injectable products such as Cartrophen™ or Adequan™ for degenerative joint disease (DJD) are also beneficial. Additional pain medications such as buprenorphine, amantadine and non-steroidal anti-inflammatory drugs (NSAIDs) may also require consideration. Elevated stages of CKD may preclude safe use of NSAIDs.

Dietary changes recommended for cats with renal disease should be considered. Many renal specific diets are formulated with reduced phosphorus; ideal, highly digestible protein sources; increased energy content; vitamins such as B12 and a range of other beneficial ingredients. The decision to commence renal diets and at what IRIS stage will vary from patient to patient. Increasing water intake may be a key factor in improving renal function and overall patient hydration status. Indirectly this can reduce pain from dehydration and constipation.

Identification of BP values over 160-180, with or without retinal changes indicate the need for BP-controlling drugs. Calcium channel blockers such as amlodipine are the most effective at controlling blood pressure in the feline species. Some patients will have partially or uncontrollable hypertension with amlodipine and may require additional medications. Benazepril (Fortekor) is not effective in the control of hypertension. The newly available drug telmisartan (Semintra) may be effective at controlling hypertension at higher doses, but has yet to be evaluated for further benefit to hypertension cats.

The indiscriminate use of antibiotics in the absence of evidence of urinary tract infection is not recommended. Antibiotics should be selected based on urine culture and sensitivity patterns. A repeat urine culture 7 days following cessation of therapy is critical. In cases where urine culture is negative, but a low USG exists in the face of renal disease, ultrasound is recommended.

Patients who exhibit even mild decreases in potassium levels in their serum require supplementation with potassium gluconate. The majority of body potassium is held in the intracellular or interstitial space. The serum potassium represents only 2% of body potassium. Therefore any decrease noted in the serum is significant of a major decrease in the overall body stores.

Elevated UPCR indicates abnormalities with the renin angiotensin aldosterone system (RAAS). These changes alter intraglomerular pressures and result in protein loss into the filtrate/urine. The use of benazepril has been recommended in the past. However, this drug is not targeted to the particular pathway of RAAS that is affected and impacting the glomerulus. Over time, the RAAS can escape the control that benazepril exerts, resulting in resumed proteinuria. Telmisartan is a new alternative that is more targeted and not likely to lead to escape mechanisms over time.

Improving hydration status in renal patients is generally considered to be beneficial to renal function and overall patient health. Addition of 20-40 mEq/L of potassium chloride to the fluids should be considered in the case of hypokalemia and/or where regular subcutaneous fluids will be administered.

Patients identified with elevated total calcium, elevated ionized calcium and/or elevated phosphorus may require phosphorus-binding agents to reduce phosphorus levels. The use of agents such as aluminum hydroxide can be challenging, as palatability is less than optimal. The use of phosphorus binding agents containing calcium should be minimized unless serial monitoring of ionized calcium can be pursued.
Calcitriol is a drug that is recommended frequently in renal patients. It’s primary indication for use is following diagnosis of renal secondary hyperparathyroidism. In these cases, the use of calcitriol, with regulated serum phosphorus levels, may benefit the patient in the short and long term. Low-dose calcitriol supplementation is recommended by some experts as a means of improving quality of life, however, more detailed studies on the benefits and risk of this approach are warranted (Sparkes et al, 2016).

Chronic kidney disease can lead to a reduced production of erythropoietin. The result is a reduced production of new red blood cells from the bone marrow. Some patients will also have iron deficiencies reducing production of new RBC. Evaluation of iron levels with consideration for supplementation is needed. These patients may also require injectable erythropoietin or darbepoietin to stimulate bone marrow production of RBC.

References
Feline Diabetes Mellitus: Is Remission a Reasonable, Achievable Goal?
Kelly St. Denis, DVM, DABVP
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Brantford, ON

Diabetes Mellitus (DM) is a common feline endocrinopathy. Most cases are primary and similar to type II diabetes in humans, which results from abnormal secretion of insulin from the pancreatic B cells and peripheral insulin resistance. The diagnosis of DM is made based on characteristic clinical signs of diabetes mellitus (polyuria, polydipsia, polyphagia, and weight loss), and documentation of hyperglycemia and glycosuria. In cats it may be complicated by the occurrence of stress hyperglycemia and sometimes stress glucosuria. When making a diagnosis of DM in cats, it is important not only to document persistent hyperglycemia and glucosuria, but also to rule out other diseases that may cause similar clinical signs. Measurement of fructosamine concentrations or urine glucose of samples collected in the home environment may allow the clinician to distinguish between stress induced hyperglycemia (and resultant glucosuria) and persistent hyperglycemia due to diabetes mellitus. Therapy for diabetes should be instituted as soon as possible after diagnosis.

The main goal of therapy is to achieve blood glucose levels within the normal range. The secondary goal is to achieve persistent normoglycemia with no further requirement for exogenous insulin. This latter goal is commonly termed diabetic remission. Diabetic remission is usually defined as the ability to maintain normal blood glucose without insulin treatment for 4 weeks without the reappearance of clinical signs. Clinicians need to accept that not all cats will achieve remission and in these patients the goal is to minimize the clinical signs without causing hypoglycaemia while avoiding excessive fluctuations of blood sugar above the normal range. The duration of remission is highly variable and unfortunately, at least 25% of cats that achieve remission subsequently become overtly diabetic and must receive insulin again. Tight glycemic control is required to achieve remission and as a result, there is an increased risk of at least one hypoglycaemic episode. This risk associated with tight glycemic control need to be discussed with the client. If this is not an approach the client is ready, willing or able to take, it may not be the ideal choice. Successful management of cats with DM includes minimizing clinical signs, improving quality of life, preventing complications such as DKA and preventing diabetic neuropathies and nephropathies. If the goal of diabetic remission is not an achievable target for the client, the clinician should continue to help them focus on the overall goals of DM management.

Administration of insulin and dietary modification are the principal therapies used for management of diabetic cats. A recent study showed that cats with newly diagnosed DM have a fair to good prognosis, with 46% living longer than 2 years. However, since 30 % of cats affected with DM are euthanized within their first year of treatment due to the emotional and financial burden of insulin treatment and the required veterinary care, achieving diabetic remission is the ideal goal for every feline patient faced with this disease. Intensive glycemic control after diagnosis has been shown in humans with DM type11 to improve long – term remission rates. It appears that the same holds true for our feline patients. Cats receiving treatment for diabetes within 6 months of diagnosis with twice daily insulin treatment aimed at euglycemia in conjunction with the cats being fed an ultra-low carbohydrate diet have the best chance of remission.

Which cat will go into remission??? Studies are suggestive that DM remission in the cat is likely to occur through reversal of glucose toxicity. As in humans, cats that have experienced more prolonged hyperglycemia will have experienced a greater deterioration of beta-cell function resulting in a lower chance of remission. There is no factor that consistently predicts diabetic remission in the cat but the shorter the duration of DM, the faster glycemic control is achieved and those patients with less severe hyperglycemia when starting appear to be factors that are favourable. A retrospective cohort study showed that cats without hypercholesterolemia were more likely to achieve remission. In one study, diabetes as a potential result of recent corticosteroid treatment was associated with nearly 50 percent remission. A lack of diabetic neuropathy has also been associated with future remission, but neuropathy is a result of prolonged hyperglycaemia so this should not be a surprise. Early client recognition, early diagnosis, intensive treatment with twice daily insulin and ultra-low carbohydrate diet are key.

One of the challenges we face as veterinarians is the opportunity to diagnose this disease in the early stages. Cats are “masters of disguise” They also do not receive regular veterinary care. Often by the time we see the patient and diagnose the disease, the cat already has lost weight and muscle mass, has a poor hair coat, glucose toxicity of the beta cells, diabetic neuropathy and possibly DKA. Using every opportunity, a veterinary team has to teach cat owners the importance of early disease diagnosis through regular veterinary care. Teaching the subtle signs of sickness is critical. The author recommends using Cat Healthy as a resource to educate every client that comes through our doors. In addition, once diagnosed with diabetes, the Cat Healthy website http://www.cathealthy.ca has a series of educational videos about diagnosis, treatment and outcome for the newly diagnosed diabetic cat family. The Cat Healthy Protocols contain a compliance section listing other useful resources for the family as they start the journey of insulin treatment and blood glucose monitoring for their cat. The earlier we diagnose and treat the disease, the better chance we have of remission.
The use of an ultra-low carbohydrate (CHO) diet is an important part of DM therapy in the cat. Low carbohydrate diets reduce post-prandial hyperglycaemia in people. It seems a low carbohydrate diet in the cat is equally important. A study giving twice daily insulin showed a 12-week remission rate of 17% in cats fed diets with variable carbohydrate content and a 12-week remission rate of 40% in diabetic cats fed an ultra-low to low carbohydrate diet. The Bennett study reported a greater chance of remission in diabetic cats fed a low-CHO diet than those fed a high fibre diet. Obesity is common in DM cats. If present, it should be addressed with a therapeutic weight-loss diet and an energy-restriction plan. Metabolic energy or resting energy requirements (MERs or RERs) should be calculated for each individual cat thus allowing determination of the actual food intake permitted for weight maintenance or weight loss (or in some cases, weight gain).

The clinician’s choice of insulin will vary depending on experience, training and current studies. Cats can theoretically achieve remission with the use of any insulin type. The type of insulin used for the best chance at achieving remission may be less important than factors such as the presence of concurrent diseases, initiating the treatment as soon as possible and the plan for close monitoring. Diseases such as Acromegaly and Cushings disease can be causes of a lack of response to insulin. Co-existing pancreatitis can also have an effect on the blood glucose levels and requirement for insulin. Clinicians should be familiar with at least two types of insulins that are appropriate for treating cats, as it is difficult to predict in advance which insulin is best for an individual cat. Glargine (Lantus™) has been proposed as the optimum insulin for diabetic cats based on the relatively high remission rate reported in some studies using this insulin, but this may be because it is the most frequently studied insulin. In a study assessing the influence of low CHO diets on remission rates, the insulin PZI (Prozinc™) achieved similar remission to a study examining twice daily glargine. Further studies are required to compare if there are different rates of remissions between the different insulins.

Table 2. Comparison of insulin products for treatment of feline diabetes mellitus

<table>
<thead>
<tr>
<th>Insulin</th>
<th>Licensed in cats</th>
<th>Manufacturer</th>
<th>Formulation</th>
<th>Action</th>
<th>Dose*</th>
</tr>
</thead>
<tbody>
<tr>
<td>ProZinc</td>
<td>Yes</td>
<td>Boehringer Ingelheim</td>
<td>U40 recombinant PZI</td>
<td>Nadir 5–7 hours Duration 8–9 hours</td>
<td>Start 0.25–0.5 U/kg, BID  Median maintenance dose 0.6 U/kg, BID</td>
</tr>
<tr>
<td>Vetsulin, Caninsulin</td>
<td>Yes</td>
<td>Merck</td>
<td>U40 Porcine zinc</td>
<td>Nadir 4 hours Duration 8–12 hours</td>
<td>Start 0.25–0.5 U/kg, BID  Median maintenance dose 0.5 U/kg, BID</td>
</tr>
<tr>
<td>Lantus</td>
<td>No</td>
<td>Sanofi Aventis</td>
<td>U100 Insulin glargine (recombinant human analog)</td>
<td>Nadir and duration not determined in diabetic cats</td>
<td>Start 0.25–0.50 U/kg, BID  Median maintenance dose 2.5 U/cat, BID</td>
</tr>
<tr>
<td>Levemir</td>
<td>No</td>
<td>Novo Nordisk</td>
<td>U100 Insulin detemir (recombinant human analog)</td>
<td>Nadir and duration not determined in diabetic cats</td>
<td>Start 0.25–0.50 U/kg, BID  Median maintenance dose 1.75 U/cat, BID</td>
</tr>
</tbody>
</table>

*Based on lean body weight

Teaching our clients to be comfortable to take blood glucose levels at home is critical for remission. “In clinic” blood glucose curves are inaccurate and a diagnostic method of the past. Having a few team members on staff that can guide the clients through the early stages of diabetic monitoring and treatment is critical and will greatly improve the chance of remission. Commonly used protocols are to “Spot Check”, do home blood glucose curves or multiple daily monitoring. What protocol is needed will be determined by the client’s schedule and lifestyle and the individual patient’s needs. It appears that remission is likely only achieved in those cats that received long term glucose monitoring.

The earlier we diagnose DM in our feline patients and initiate treatment with twice daily insulin in conjunction with an ultra-low carbohydrate diet, the better chance we have of diabetic remission. Teaching clients to monitor blood glucose levels at home is a critical part of the plan as well. Remission in the diabetic cat is possible!

References

These lecture notes and associated presentation were modified from a previous presentation by Dr. St. Denis and Dr. O’Brien at the Ontario Veterinary Medical Association 2017 conference & Trade Show.
Identifying the underlying cause of house soiling can be problematic. House soiling often occurs as a result of multiple issues, which may include medical, environmental and/or anxiety-related issues. The main medical differential diagnoses for feline house soiling include feline idiopathic/interstitial cystitis (FIC), urolithiasis, crystalluria, infection, constipation, dehydration and/or neoplasia. Environmental concerns may include insufficient availability of resources such as litter boxes, feeding stations and sleeping locations (to name a few). Poor litter box management such as covered boxes, infrequently cleaned or inconveniently located boxes, may also contribute. Anxiety may arise from a wide variety of problems including illness, inconsistent provision of daily care (feeding, play etc.), insufficient resources, inter cat aggression, as well as territorial anxiety. Intact males or males neutered after puberty may be more prone to house soiling in the form of territorial urine marking.

When a cat is presented with house soiling, a detailed history including information about the cat’s age, home environment, census of other pets in the home, behaviour, diet (including treats), water intake and other concerns are critical. History is followed up with a thorough physical examination with attention to the palpation of the abdomen. Is their pain? Does palpation of the bladder illicit urination? Does the bladder feel soft, thickened, firm? Is there evidence of firm, small stool and/or evidence of constipation? Does the cat have a urinary obstruction which requires immediate resolution? All cats with house soiling require a basic urinalysis which includes visual assessment, specific gravity, dipstick analysis, and sediment microscopy. This includes cats with fecal house soiling, as some of these patients may have painful urination, leading them to defecate away from the pain-associated litter box. Blood work should be considered as an important part of the minimum data base required to rule out systemic disease. Depending on the findings, further investigations should then include radiographs of the abdomen and if needed ultrasound imaging of the bladder to identify evidence of constipation, urolithiasis or neoplasia. Urine culture and sensitivity should be carried out for any cat with an active sediment (WBC, bacteria), low urine specific gravity and/or glucosuria. Urine cultures should be obtained only by cystocentesis to prevent false positive results from contamination during a free-flow sample.

Feline idiopathic cystitis (FIC)
Feline idiopathic cystitis (FIC) is a complex disease process in cats that is not fully understood. The condition is often a diagnoses of exclusion, after all other potential medical causes have been ruled out. It is important to realize that FIC can occur as a result of contributing factors such as environmental mismanagement and anxiety. It is therefore difficult to tease out many factors related to FIC from factors associated with house soiling. The clinical signs of FIC may include pollakiuria, periuria, dysuria, hematuria and/or stranguria. Vocalization when urinating and hair loss on the ventral caudal abdomen may also occur. The severity of signs and the frequency with which they recur is variable. FIC can be obstructive or non-obstructive in its presentation. It is the most common cause of non-obstructive feline lower urinary disease.¹ This disease is generally seen in younger and middle aged cats and is uncommonly diagnosed in cats greater than 10 years of age. In reported studies, excessive body weight, decreased activity, multiple cat households and indoor housing have been associated with increased of FIC. Affected cats can suffer recurrent episodes, which generally resolve without treatment over the course of 3–7 days. FIC can present as an acute episode or develop into a chronic re-occurring condition. While the condition of FIC currently remains, by definition, an idiopathic disorder, recent developments in the understanding of the neuro-hormonal abnormalities that exist in affected cats suggest that the signs develop from an inability to cope with chronic stress. This may manifest in a number of ways, including the development of bladder inflammation and pain.² No cure is currently available for FIC, and treatment options are aimed at keeping the cat's clinical signs to a minimum, and increasing the disease-free interval. Clinical signs of acute FIC resolve spontaneously in as many as 85% of cats within 2-3 days, with or without treatment. Assessing the efficacy of any medical treatment for FIC is made difficult by the self-limiting nature of this disease. When a cat is diagnosed with FIC, analgesic therapy should be initiated for the acute management of the disease. These cats are painful and the pain needs to be treated in a multi-modal fashion with opioids, non-steroidal inflammatory drugs and other analgesics such as gabapentin. Prazosin hydrochloride may be helpful to relieve urethral spasm. It is important that the client appreciates that all current treatments for FIC are merely palliative and that without application of multi-modal environmental modification (MEMO) and measures to increase water intake, the FIC episodes will recur and will require continued management. A primary objective in managing FIC is to encourage the production of large volumes of dilute urine (SG < 1.035). Any measures which will increase the cat’s water intake are likely to be helpful. Feeding canned food is particularly effective, as is offering the cat palatable fluids to drink (chicken or fish stock, water from tinned fish, etc.). Adding extra water to canned or dry foods works well. Monitoring of the success of the owner's attempts to increase water intake can be done via regular analysis of the urine samples collected at home or in the clinic. Aim is to keep the urine SG below 1.035.
Environmental management

Environmental modification is a key factor in the management of house soiling, since stress clearly plays an important part in the problem. Meeting the environmental needs of the cat and understanding the cat as a species is critical. Cats are not inherently social and in the wild are solitary hunters. They tend to be solitary and are territorial and although they are hunters, they are also prey. These traits make it challenging for cats to live in close proximity to other cats. ‘Silent bullying’ often goes unnoticed, but it is a major cause of chronic stress to the less dominant cat. When a cat is presented for house soiling, a questionnaire should be completed by the client to establish a thorough environmental history, followed by the recommendations for MEMO. For suggestions on developing a questionnaire, as well as a good client resource, the reader is referred to the following websites: http://www.indoorcat.org/ and http://www.cathealthy.ca.

Identifying and addressing environmental management issues in the affected households is a critical aspect in the reduction of house soiling. This applies to all causes of house soiling, but is of particular importance in cats with FIC. In one study, multi-modal environmental modification (MEMO) was evaluated in client-owned cats with FIC. Implementing MEMO as the sole management strategy with FIC was found to be successful in the majority of cats followed over a one year period of time.3

Dietary adjustments

Diets such as Royal Canin Calm® or Royal Canin Urinary/Calm® and Hill’s Multicare C/D Stress® can be helpful in the long-term management of cats with house soiling issues, especially those with FIC. These type of diets reduce the frequency and intensity of recurring episodes of lower urinary tract signs. To achieve this aim, they need to be fed as the cat’s sole source of nutrition and used consistently in the long term. Calming nutraceuticals such as Zylkene® or Anxitane® may be helpful.

As cats that develop litter box issues, degenerative joint disease, and in particular FIC tend to be overweight, a weight loss program with a strict calorie counted amount of food fed per day is likely critical.

Resource management

To meet the needs of each cat within the house, each individual cat must have free access to its own key resources, ideally positioned out of sight of the other cats. Key resources include food and water bowls that are sited apart from each other; clean uncovered litter trays (one box per cat, plus one) in various locations around the home; resting places at different vertical heights with some that only fit one individual cat; and multiple scratching posts and scratching resources. Cats need mental and physical activity several times a day and cat families need to make time in their day to play with their cat as they would their dog. Putting the hunt back in meal-time using feeding toys is a good form of entertainment for the “predator” in the cat.

Feline pheromones

Although a statistically significant difference was not found when Feliway® was used in a home compared to placebo in cats with FIC, cats that had Feliway® used in the environment had a trend for fewer bouts of FIC and reduced negative behavioral traits.

Pharmacologic interventions

A variety of drugs have been tried in cats with housesoiling concerns, but their efficacy will vary with each cat in each separate situation. All medical, dietary, environmental and resource concerns must be addressed prior to or in conjunction with the use of pharmacologic agents in feline house soiling. Expectation that a drug may resolve house soiling on it’s own without these concerns being addressed is unrealistic and more likely to lead to treatment failure. Selection of drugs will be based on the identified areas of concern, whether these are anxiety based, or secondary to aggression or timidity in a multicat household.

Urinary tract infection

Bacterial infections are rare and most likely seen in older female cats with a low urine specific gravity or cats with glucosuria. Cats presenting with house soiling and/or evidence of FIC should not be prescribed empirical antimicrobials. As the condition of FIC is waxing and waning, it may appear that the cat has responded to antimicrobials which will lead to a false diagnosis of infection. Rarely do cats have a bacterial infection, even when they have a urolith. The need for antibiotics should be based on a positive urine culture and treatment selected according to the sensitivity results.

References


These lecture notes and associated presentation were modified from a previous presentation by Dr. St. Dens and Dr. O’Brien at the Ontario Veterinary Medical Association 2017 conference & Trade Show.
Inter-Cat Aggression:  
I Love You, You Love Me  
Kelly St. Denis, DVM, DABVP  
Charing Cross Cat Clinic  
Brantford, ON  

The feline species may generally be considered to be a solitary creature where social interactions are concerned, but domestication has allowed the adaptation to living in social communities with both humans and other cats. Domestic cats are well known to be able to develop bonds with humans and other cats. The ability to socialize with other cats and humans will vary between individual cats as a function of their genetics, prenatal environment, early socialization and life experiences. The acceptability of other cats within the household will in part depend on the history of the cats in question, including how and when introductions were made. One of the most common causes of inter-cat aggression issues is introduction of a new cat into a pre-existing social environment of a household with 1 cat or 1 or more pets. Other causes of inter-cat aggression include play aggression, territorial aggression, fear aggression and redirected aggression.

Cats that cohabitate are in many cases able to develop a social bond, or at least co-exist in the same environment. Cats that are bonded and not experiencing inter-cat anxiety will allogroom, allo-rub, allo-play, and sleep in close or direct physical proximity to one another. This is called affiliative behavior. Allogrooming and other cat-cat behaviors such as play should not end in physical or vocal violence. For example, cats that allogroom for a short duration followed by swatting and/or hissing and growling are not likely to be living in complete harmony with one another. Cats that cohabitate may not exhibit overt signs of aggression. Agonistic behavior can be subtle, and clients may not recognize the signs. Cats can exhibit signs of aggression simply through certain facial expressions and body positioning. Clients may not be aware of the subtle facial and body language that indicates an aggressor or defensor. Clients may not be aware of the moderately subtle signs such as physical blocking of access to resources, or passive blocking of access to resources (e.g. staring). Clients may consider chasing to be a form of play when it is in fact the act of an aggressor towards a defensive cat. Normal play between cats should involved reciprocal chasing with minimal to no vocalization. Clients are more likely to be aware of agonistic behavior that is obvious, including biting and scratching and full physical fights.

When a client approaches the veterinary team for assistance with an inter-cat aggression problem, it is critical for the clinician to delve into the history of the cats in question. Affiliative and agonistic behaviors may be in their history, but the client may have always assumed the cats were affiliative. Teasing out a history of inter-cat anxiety is important to developing a treatment plan for the current aggression problem. As with aggression towards humans (see Feline Aggression Towards Humans - Prevention and management), the clinician will need to determine the forms of aggression that are being exhibited. This includes sorting out a history of play aggression, determining if there are territorial issues, whether there is fear and whether a redirected aggression episode occurred. The situation can be multifactorial. For example, two cohabiting cats may have always had territorial and fear aggression that was subtle. This subtle issue may suddenly become a major issue when a new cat is brought into the house or an outdoor stray presents itself at the window. In the case of a new household pet, the group dynamics must shift and in the case of outdoor cats, redirected aggression may worsen the situation.

Goals for the behavioral interview and development of a treatment plan

1. Identify underlying motivation for the behavior  
2. Identify pre-existing inter-cat issues (perhaps client was never aware)  
3. Correctly identify the aggressor(s) and the defensor(s)  
4. Identify triggers and formulate a plan on how to avoid these  
5. Review enrichment and resource management. Correct any deficiencies.  
6. Develop a treatment plan

Questions to ask during the behavioral interview

Basic information should be gathered about the patient signalment, household members (people and animals), patient medical history and how/where the pet was acquired. The environment should be reviewed, including resource management and availability, litter box care, and household enrichment. The patient’s daily activities should be reviewed and in cases of house calls, traced throughout the house layout. Relationships with other pets in the house and with humans in the household should be reviewed. The stability of the human population should be assessed. For example, humans that work shift work hours may be home inconsistently, causing the patient’s environment to be inconsistent.

The incident considered the initiating incident, as well as further incidents should be reviewed in detail. There should be an examination of the frequency, intensity and severity of the behavior(s) in question. The behavior of all of the affected cats and subsequent responses should be determined. Videotaping of these incidents can be very helpful to the clinician, allowing direct
visualization of body language rather than relying on the client’s memory. Any attempts at treatment or punishment should be reviewed as these may negatively impact the prognosis.

House calls are often the best approach to pursuing a behavior consultation, as the clinician can see first hand the environment that the cats live in, what resources are available and where incidents occurred. PLEASE NOTE: Where inter-cat aggression has become so severe that the cats cannot see each other without erupting into vocal and physical violence, they should be separated until such time as a treatment plan can be developed. During the home behavioral consultation, the cats should NOT be reintroduced to allow the veterinarian to see ‘what happens’. This can be potentially dangerous to cats and humans. The veterinarian must rely on the information gleaned during the interview as well as an video the client has.

Points to consider with regards to the potential success of treatment
Inter-cat aggression can disrupt animal bonds for life. The ability of two or more cats to live together again after the aggression has become severe may be limited. Reconciliation may be impossible. As with cat-human aggression, a frank, open discussion is necessary with the client(s) in order to determine the prognosis for the patient. It is important to determine how bad the aggression has become and whether this has also affected the human-animal bond. The clinician will need a frank admission by the client about how willing they are to implement the outlined treatment plan. The clients will need to be open about what options they are considering. Options may include following the prescribed treatment plan, drugs, relinquishment and/or euthanasia. Further, the clients’ expectations must be known. What are the clients’ goals and timeline? The clients may have unrealistic expectations, desiring complete resolution of the problem.

Resource management: Critical in multi-pet environments
Resource management in a multi-pet environment is critical to reducing territorial anxiety in cats. While litter box resources are often considered during house soiling consultations, these represent only one facet of household resources that are important to indoor cats:

- Litter boxes
- Sleeping and resting areas
- Food bowls
- Water bowls
- Toys
- Perches
- Scratch posts
- Scratching surfaces

Litter boxes should be provided at a ratio of one litter box per cat, plus one additional box. The boxes should not be located in the same room, and not all on the same level of the house. Suitable box size, unscented clumping litter substrate and coverless boxes should be used. Regular, daily or twice daily scooping of the boxes is necessary. Sleeping and resting locations should be ample to accommodate all cats in a variety of locations. Most cats do not wish to sleep close to other cats, which means that sleeping and resting locations should be distributed widely throughout the household. Some of the scratch posts and perches should be located near windows, to allow the cat to visualize outdoor activities such as birds and squirrels, which is mentally stimulating for the cat. In cases where outdoor cats or animals are causing territorial anxiety, the yard view may need to be blocked temporarily. Other scratch surfaces should be located near sleeping spots, so that the cat who wishes to scratch and stretch after a nap has immediate access to an acceptable scratching surface. The client may choose to place scratching surfaces in both busy and quiet areas of the household, so that the cat has multiple locations to scratch.

For most cats, catnip and catnip spray help to encourage use of these articles. It is important to note that kittens under four months of age will not respond to catnip and some rare adult cats are actually non-responders.

Food can be a major source of anxiety in multi-cat households. Ideally, cats should be fed three-four meals a day, in separate rooms. Cats fed within visual, olfactory and/or auditory distance of each other may experience anxiety as they eat. This may not be obvious to the client, as signs can be subtle. Some cats may eat their food rapidly, others may move from bowl to bowl, sometimes pushing the other cat away. Some cats may eat and then move to another area of the household to mark territory in an expression of their anxiety. The client should ensure that one cat is not bullying the other cat away from its food. It is usually necessary to confine cats to separate rooms for feeding. Water bowls need to be distributed throughout the household.

Toys should be ample in number, with types of toys being rotated every week if at all possible.

Dietary adjustments
Diets such as Royal Canin Calm® or Royal Canin Urinary/Calm® and Hill’s Multicare C/D Stress® can be helpful in the long-term management of intercat anxieties. To achieve effect, they need to be fed as the cat's sole source of nutrition and used consistently in the long term. Calming nutraceuticals such as Zylkene ® or Anxitane® may be helpful.
Medications
Determining aggressor and defensor is a critical point in development of an appropriate treatment plan. This is most true when selecting potential behavior modifying drugs for each cat. For example, selection of a drug that will improve the confidence of a defensor, when the aggressor has been misidentified as the defensor can have disastrous consequences. The author refers the reader to the AAFP Behavior Guidelines booklet, which contains a thorough review of the available pharmaceuticals and the targeted individual for each of these drugs. Some of these drugs will be discussed during the lecture.


Prognosis
The ability to resolve inter cat aggression is going to depend on many factors. First and foremost, it is going to depend on the points noted above, as to what client expectations are and whether they are willing to follow prescribed treatment plans. If this is not the case, then the chances of success diminish greatly. Secondly, the duration of the problem, and third, its severity, will impact the chance to implement change. Setting realistic expectations and realistic time frames for achieving goals early on in the consultation process is more likely to set the stage for success or at least partial resolution. Clients and clinicians should understand the limitations of the problem and what is reasonable to expect from treatment.

Sample questionnaire for a home behavior consultation
Patient ID:
Patient Signalment:
Medical Conditions:
1.
2.
3.
Current Medications:
1.
2.
3.
What amount of day does cat spend in the following activities?
Sleeping
Resting
Eating
Grooming
Hiding
Playing Alone
Playing with human
Playing with other cat
How often does cat use litter box for BM? U?
Other Pets
1.
2.
3.
Environment:
Layout- rough drawings attached- Y N

Environmental resources
Litter boxes
Number
Location
Characteristics
Feeding Stations
Number
Location
Characteristics
Feeding Schedule
Food
Amount
Timing
Private Locations/Hidey spots
Number
Location
Used?
Elevated Locations/3D space Availability  Number
Location
Used?
Windows
Location
Look out onto:
Other environmental enrichment:
Toys:
Directive play with client:
Potential external stressors noted outdoors:
Unique considerations (ex. flooring type, smoking, cleanliness, clutter, noise levels)
Social Interactions
Humans
Number
Stability of residence
Stability of employment hours:
Relationship with Cat:
Other regular visitors:
Dogs
Cats
How long have cats lived together?
Do they groom each other?
How often?
Do they rest/sleep together?
Do they stay in the same room together?
Does one ever avoid the other?
Does one cat ever block access to the food or resources?
Do they play together?
Describe the play
Before the current incident have there ever been any incidents of concern?
Has either cat ever shown any aggression towards people or other pets?

Specific incidents reported
Known Triggers of Aggression:
Aggression directed towards:
Client/Individual reaction to aggressive behavior:
Any punishments used?
Yelling, swatting, other
Veterinarian Interactions with Cat during visit:

References
It’s Just a Hairball…or is it? Understanding the Vomiting Cat
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Clients and veterinarians often consider that vomiting in cats is a regular occurrence that is not significant of health problems. This is a particularly common assumption with regard to vomit containing hairballs. Cats spend approximately 25% of their waking hours grooming (Panaman et al, 1981). The majority of ingested hair passes through the cat’s digestive tract into the feces with no negative side effects (Panaman et al, 1981). Cats that vomit occasionally may not be considered to have any specific underlying gastrointestinal disease (GID). However, cats that are vomiting more often than every 2 weeks are significantly more likely to have some baseline underlying GID (Norsworthy et al, 2015).

During routine preventive care examinations, detailed questioning about diet, diet changes, vomiting and hairballs is essential. When clients are uncertain about vomiting and/or hairball frequency, a calendar recording system should be recommended. In addition to regular vomiting, the patient may be showing signs of nausea that are not obvious to the client. These signs might include a finicky appetite, occasional loss of appetite or periods of anorexia, licking of the lips, gagging, and/or ingestion of grass to stimulate vomiting.

A history of abnormal bowel movements should also be investigated. Diarrhea can occur in conjunction with upper GID, or as a manifestation of lower GID. The veterinarian should also carefully question the client to identify evidence of constipation. Conditions such as inflammatory bowel disease (IBD) can exist as a problem within the small intestine, combined small intestine/large intestine or solely the large intestine. Vomiting, diarrhea and/or constipation may manifest as a result.

A thorough physical examination of the vomiting cat will help elucidate signs of nausea. The patient should be observed for signs of lip licking and frequent swallowing. A thorough oral health examination may reveal foreign objects looped under the tongue, oral ulceration or other oral or dental disease that may impact appetite and vomiting.

Feline patient weights should be recorded on every visit to the clinic, as subtle weight loss can be one of the first signs of disease. The documentation of weight loss in a cat with frequent vomiting may be the only physical examination change noted. This change can be a hallmark of mild to significant GID.

The abdomen should be examined in quadrants and the patient carefully observed for evidence of nausea or pain during palpation of each quadrant. Evidence of pain during abdominal palpation may include very subtle changes. The patient’s face should be monitored closely for evidence of lip licking, wincing, blinking or other facial expression changes that could indicate pain. The patient may growl or hiss, although this is rare. Guarding of the abdomen during palpation of the painful quadrant(s) may also be observed. Abnormal findings during the palpation may include evidence of an enlarged liver, distended stomach, thickened/ropy intestines, abdominal fluid, masses and/or enlarged lymph nodes.

Making a diagnosis
The list of differential diagnoses in the adult and senior feline patient with chronic vomiting is long and complex. In all cases, a minimum database (MDB) plus a gastrointestinal (GI) profile is ideal for diagnostic testing. The GI profile should include cobalamin (B12), folate, feline specific pancreatic lipase (sfPL) & in many cases, trypsin-like immunoreactivity (TLI)

The patient’s feline leukemia virus (FeLV) and feline immunodeficiency virus (FIV) status should be determined. Feline leukemia virus is a known cause of lymphoma in the feline patient. However, with the introduction of vaccination against FeLV, there has been a shift in the types of intestinal lymphoma in cats ( Cotter et al, 2011; Louwerens et al, 2005). This shift does not change the value of knowing the patient’s retroviral status, as disease management will be impacted by retrovirus infection.

Radiography is beneficial in elimination of some differential diagnoses in the vomiting cat. In older cats, the presence of neoplastic lesions within the thorax may be the only identifiable source of vomiting. Abdominal radiographs will be beneficial in identifying some foreign bodies, masses, intestinal accidents, and other changes. Evaluation of skeletal structures may indicate the presence of painful spondylosis, osteoarthritis and/or degenerative joint disease.

Ultrasonographic imaging is beneficial in identifying GI organ abnormalities (liver, gall bladder, spleen, pancreas) as well as the urinary tract. The intestines can be evaluated for abnormal gut motility, obstruction, or other intestinal accidents (ex. intussusception). The abdomen can be evaluated for a discrete mass or masses, including evidence of lymph node enlargement. Evaluation of intestinal wall thickness, as well as thickness and integrity of the four intestinal wall layers may help identify the presence of intramural disease such as IBD and lymphoma. Ultrasound changes associated with pancreatitis may be evident (Forman et al, 2004). The sensitivity of ultrasound in the diagnosis of pancreatitis is low (Cosford et al, 2010; Forman et al, 2004; Gerhardt et al, 2001).

Where clinical signs and laboratory studies are strongly indicative of disease such as IBD, lymphoma (diffuse neoplasia), discrete neoplasia, hepatitis, cholangitis, cholangiohepatitis and/or pancreatitis, biopsy is warranted. The decision to pursue endoscopy versus
full abdominal exploratory may be impacted by the findings, the relative invasiveness of each procedure and cost. Exploratory surgery permits full visual assessment of all intra abdominal organs, biopsy of extra-intestinal tissues (liver, pancreas, lymph nodes etc) and full thickness intestinal biopsy (Kleinschmidt et al, 2010).

**Symptomatic, targeted and empirical therapies**

Dietary changes may be beneficial to the patient with GID. Changing dietary format, such as dry to canned food, may improve digestion. The use of veterinary formulations that are easy to digest such as Royal Canin Gastro, Hill’s i/d or PVD EN may reduce or in some cases eliminate active GID signs. The role of dietary allergens in IBD and other GID is difficult to confirm. Food-responsive enteropathy is characterized by signs similar to other GID, although large bowel signs are more often observed and cutaneous disease may also be present. (Jergens et al, 2012).

Anti-emetics such as maropitant (Cerenia™) may be beneficial to the vomiting patient. Drugs with pro-kinetic effects should be used with caution in case of obstruction. Gastric acid blockers such as ranitidine and omeprazole are less likely to play a beneficial role in feline patients with GID.

Appetite stimulants for loss of appetite or anorexia may be beneficial in improving intake, but in the presence of nausea and GI inflammation, these drugs are likely to be of little utility until underlying disease is addressed. Mirtazapine provides both appetite stimulant and anti-nausea activity, making it a beneficial option in certain cases of feline GID.

Patients with GID may be experiencing pain as a result of or concurrent to their GID. As the signs of pain in the feline patient can be subtle at best, any conditions identified as potentially painful should be treated as such. Gabapentin, buprenorphine and non-steroidal anti-inflammatories are all beneficial in pain management. Multimodal analgesic protocols are most effective over single drug therapy.

It has been recommended that all cats with signs of GID and a serum cobalamin of <300ng/L should receive parenteral supplementation of cobalamin (Ruaux et al, 2005). The current supplementation dosage recommendations from Texas A&M University (TAMU) are 250 micrograms cobalamin SQ once weekly for 6 weeks followed by 250 micrograms one month later. Thirty days following this injection, a repeat measurement of B12 is recommended [http://vetmed.tamu.edu/gilab/research/cobalamin-information](http://vetmed.tamu.edu/gilab/research/cobalamin-information).

The empirical use of steroids is generally not recommended in any situation in feline medicine, however, this is a frequently used therapeutic in feline GID patients. Limitations of finances and client willingness to pursue diagnostic biopsy may impact the treatment selection process. Empirical steroid usage precludes or limits usefulness of ultrasound or biopsy, as the drugs will change the local inflammatory pattern, thus confounding diagnosis. Where steroids are to be employed, urine culture should be considered prior to drug initiation, in order to rule out occult UTI. Prednisolone or dexamethasone are the steroids of choice in cases of IBD or GI lymphoma. The author does not recommend the use of depot steroids such as methylprednisolone acetate. The usefulness of budesonide is questionable, although it may offer benefits as an adjunct therapy. Empirical use of cyclosporine or chlorambucil is not recommended.

**References**


Jergens AE. Feline idiopathic inflammatory bowel disease: what we know and what remains to be unraveled. *J Fel Med Surg* 2012;14:445–458


Think Like a Cat:  
How to be Feline Friendly at Home and in the Practice  
Kelly St. Denis, DVM, DABVP  
Charing Cross Cat Clinic  
Brantford, ON

Cats do not see or experience the world the way we do. Understanding natural cat instincts can help us improve environmental enrichment at home, as well as improving veterinary visits for cats. In a natural environment, cats are predators AND prey. We frequently think of cats as hunters but forget that they are also hunted. Cats must be on the alert even in their own homes, and particularly at the veterinary clinic. This is the baseline instinct that can lead to negative behaviors both at home and in the clinic.

The cat’s unique senses
The unique senses of the cat impact how they interact with their world. Cats communicate through olfactory, visual, tactile and auditory means. A cat’s sense of smell is significantly more sensitive than a human. They perceive their world in overlapping clouds of smell. This in itself can lead to a heightened sense of awareness in the examination room. Although we believe we thoroughly clean our hospitals, many scents remain behind to arouse our feline patients. This can lead to redirected aggression or fear in the examination room. Vision at night for cats may be good, thanks to the retinal tapetal reflective tissue. Since they primarily hunt at night, our feline friends have little need for colour vision. The feline range of vision is best at 2-6 metres. Close up, feline vision is less than ideal, thus impacting their stress levels when foreign items are close by (this includes cucumbers, which can completely traumatize the unsuspecting feline). The feline binocular vision which has a 98 degree overlap allows for accurate assessment and judgement of distance. Cats have amazing hearing, using their pinna to rotate and collect as many surrounding sounds as possible. The pinna can swivel almost 180 degrees and move independently of one another. This helps them to track and locate prey, but also to detect predators. Remote sounds from outside of the examination room can be frightening to the feline patient.

Tactile senses permit communication with fellow felines and other species, including the veterinarian. Their responses can include affiliate communication like rubbing, head bunting, nose touching, kneading, treading and allo-grooming. Negative or agonistic communication can include biting and scratching.

Cats are easily threatened. Their response to threats is to flee, freeze or fight. As veterinarians we have all experienced this range of reaction in our feline patients. Our patients communicate with us by many visual cues. Understanding these is critical to improving feline visits. We need to monitor their posture, examine their facial expressions and respond accordingly.

Home environment
As obligate carnivores and solitary hunters, cats tend to be territorial and find safety in predictability of their surrounding environment. As household members, most clients understand that their cats are schedule-oriented. Cats appreciate consistency, know when mealtime has arrived, and are stressed by disruptions in their regular routines as well as by additions to the family (humans and other pets alike). Provision of appropriate resources will also go a long way to maintaining health and normal behavior. Resource management in a multi-pet environment is critical for cats, particularly those in a multi-pet household, or where young children reside. While litter box resources are often considered during house soiling consultations, these represent only one facet of household resources that are important to indoor cats:

- Litter boxes
- Sleeping and resting areas
- Food bowls
- Water bowls
- Toys
- Perches
- Scratch posts
- Scratching surfaces

Litter boxes should be provided at a ratio of one litter box per cat, plus one additional box. The boxes should not be located in the same room, and not all on the same level of the house. Suitable box size, unscented clumping litter substrate and coverless boxes should be used. Regular, daily or twice daily scooping of the boxes is necessary. Sleeping and resting locations should be ample to accommodate all cats in a variety of locations. Most cats do not wish to sleep close to other cats, which means that sleeping and resting locations should be distributed widely throughout the household. Some of the scratch posts and perches should be located near windows, to allow the cat to visualize outdoor activities such as birds and squirrels, which is mentally stimulating for the cat. In cases where outdoor cats or animals are causing territorial anxiety, the yard view may need to be blocked temporarily. Other scratch surfaces should be located near sleeping spots, so that the cat who wishes to scratch and stretch after a nap has immediate access to an
acceptable scratching surface. The client may choose to place scratching surfaces in both busy and quiet areas of the household, so that the cat has multiple locations to scratch.

More information can be found in the following brochure:

http://www.catvets.com/public/PDFs/ClientBrochures/Environmental%20GuidelinesEViewFinal.pdf and on the following website:

https://indoortpet.osu.edu/cats/basic-indoor-cat-needs

Food can be a major source of anxiety in multi-cat households. Ideally, cats should be fed three-four meals a day, in separate rooms. Cats fed within visual, olfactory and/or auditory distance of each other or other pets such as dogs, may experience anxiety as they eat. This may not be obvious to the client, as signs can be subtle. Some cats may eat their food rapidly, others may move from bowl to bowl, sometimes pushing the other cat away. Some cats may eat and then move to another area of the household to mark territory in an expression of their anxiety. Water bowls need to be distributed throughout the household. Toys should be ample in number, with types of toys being rotated every week if at all possible.

The veterinary visit

Step 1: It starts at home

Feline friendly handling starts when clients are scheduling the cat’s appointment. In advance of potential issues, asking the owner about their access to a good carrier, their ability to get the cat into the carrier and what experiences they have had in the past are important to addressing problems before they occur. A telephone script for all staff to use may be beneficial. Any previous issues should have been documented in the patient file for easy reference.

The provision of carrier-friendly resource materials and support is key. Many clinics provide information on the selection of the ideal carrier for cat transportation. In situations where clients may not own a carrier, or do not have a sufficiently secure or ideal carrier, clinics should offer a carrier on loan.

There are several pamphlets available that provide tips on travelling to the clinic with a cat. The American Association of Feline Practitioners (AAFP) pamphlet entitled ‘Getting your cat to the Veterinarian’ (Figure 1; http://www.catvets.com/cat-owners/brochures) is an excellent resource for clients. This type of literature should be provided well in advance of the veterinary visit.

Feline facial pheromones (Feliway) are frequently useful in the reduction of stress. In advance of travel, clients may wish to spray Feliway onto a cloth and place it in the carrier with the cat. Alternatively, clinics can provide the client with Feliway-infused cloth pieces, sealed into zip-lock bags. For some cats, a Feliway infused cloth will reduce agitation, vocalization and soiling during transport.

Step 2: Feline friendly waiting

Calming the feline patient and the client is critical from the moment they enter the clinic. Minimizing loud noises and reducing visual and auditory exposure to dogs is ideal. The existence of a feline friendly waiting area or a separate waiting room can significantly reduce the stress for both patient and client. If a waiting room is too chaotic, the patient and client should be moved immediately to their examination room. Reduced or non-existent wait-times assist in avoiding a buildup of tension in the waiting feline patient. Some clinics offer feline exclusive appointment hours. Clinics may also choose to have feline exclusive examination rooms.

A cat friendly advocate should be appointed in each practice. This individual should be instrumental in helping the practice achieve an optimal feline friendly environment. The appointed staff member should mark a goal of achieving AAFP feline friendly practice status (http://www.catvets.com/cfp/veterinary-professionals).

Step 3: A feline friendly outpatient visit

During the patient’s visit, the veterinary team must continue to strive to reduce stress. In advance of significant handling, the patient should be assessed for pain and treated appropriately. Sedatives should be employed where necessary. Physical restraint should be avoided.

The ambience in the consultation room is of critical consideration. Clinical settings can be harsh to the feline senses. Clinical settings often have strong odors of cleaning solutions, medicinal smells and the scents of other animals. The lighting may be bright and harsh. Examination surfaces are often hard and unforgiving. Stainless steel surfaces may give off disturbing reflections. Thin gauge stainless steel surfaces are known to shift, and as a result may make unsettling noises. Brushed stainless steel surfaces give off less reflection, which can reduce stress.

Soften it up

Provision of soft, fuzzy blankets and table top cushioning are valuable for all cat age groups, but in particular for the old and sick. Infusion of blankets with Feliway can further improve relaxation.

Warm it up

Cats prefer warmer ambient temperatures than humans. The relative warmth of the room air should be addressed. Warming blankets in a spa or medical towel warmer in advance of use can be very beneficial. Alternatively, heated oat bags can be used in a designated drawer to warm patient blankets.

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**Darken it up**
Bright, overhead fluorescent lighting has an important role in the medical examination. However, it is not a necessity during the entire visit. Use of softer incandescent lighting for the majority of the appointment will be more appealing to the feline patient.

**Keep it quiet**
The location of the feline examination room relative to other parts of the clinic may not be alterable. Still, consideration should be given to external noises that may frighten the feline patient. This includes barking dogs, delivery of supplies and loud veterinary equipment such as dental and laundry machines. If the examination room location cannot be altered, then the timing of feline examinations should be carefully planned to avoid these noises. Feline exclusive consultation hours can be beneficial in these scenarios.

**Make it calming with feline facial pheromones**
A Feliway diffuser should be plugged into an outlet in the feline examination room more than 30 minutes prior to commencement of appointment hours (Figure 3).

**Keep it scent free**
While the selection of cleaners for the examination is critical to reduce transmission of disease, it is best to select those with reduced odour. Cleaners should be used as far in advance as possible of the next appointment, in order to ensure that the majority of cleaner scent has dissipated. Soft towels used on surfaces can be removed for washing and will reduce the amount of surface cleaning required.

Soiling or spraying by other patients should be addressed well in advance of the next appointment. The affected areas should be cleaned. In some cases, Feliway spray at the location of soiling will reduce further anxiety in the next patient. Garbage cans containing either urine soaked towels or fecal matter should be emptied and cleaned. In extreme situations, it may be ideal to shift to an alternate examination room until offensive scents can be eliminated.

**Let the cat own the room**
Prior to the physical examination, the consultation should begin with conversation between owner and veterinary team member. The cat carrier should be placed on the floor in the examination room and the patient allowed to enter or exit the carrier at will. The patient should not be forced from the carrier. While the conversation continues, the patient should be permitted to explore the consultation room. Familiarization with the room, including being permitted into and onto objects as well as facial marking, will serve to reduce the patient’s stress levels. When it is time to examine the patient, the lid should be removed from the carrier and reluctant participants gently lifted out.

**The benefits of pain management**
Cats are masters at hiding illness. Concealing pain is no exception. For some painful cats, a defensive or offensive response to handling is a matter of apparent self-preservation. Predicting pain and understanding pain is critical to a feline friendly approach to handling.

Individual practices should establish or adopt a pain index within the veterinary practice. Colorado State University has developed a pain scale system that can be utilized in veterinary practices. (http://www.csuanimalcancercenter.org/assets/files/csu_acute_pain_scale_feline.pdf). All staff should be trained to use a pain index consistently. This allows for a standardized approach to the assessment of feline pain. Every patient should be evaluated prior to any other handling, including the physical examination. The mildest handling of a painful patient may provoke a negative response. Identification of the painful cat allows the clinician to employ pain management techniques prior to further handling.

**Step 4: Inpatient care**
The stress of illness can reduce a cat’s tolerance for handling. Dehydration and the tissue trauma associated with illness can cause pain. Sources of stress and pain must be addressed in the intensive care unit (ICU) patient in order to improve recovery.

Patient housing should be at a distance from the noise and smell of canine patients, if at all possible. Other nearby noises should be minimized. Conversations should be kept quiet. Dimmed lighting should be considered.

Within the ICU, patients should be provided with a thick, warm layer of blankets (Figure 4). Soft or fuzzy surfaced blankets are generally preferred. The use of newsprint paper provides no comfort, is cold and unyielding. Warmed oat bags placed under the blankets will improve the ambient temperature of the ICU cage. Provision of boxes or make-shift tents allow the patient to conceal themselves within the ICU cage. A Feliway™ infused cloth or warmed Feliway™-infused blankets can be placed within the ICU cage. The litter box provided to the ICU patient should be wide, low-walled with soft textured, unscented litter.
As cats reach their senior and geriatric years, our focus on their health needs to intensify. Cats age rapidly. The domestic cat reaches its prime by 3 to 6 years of age. At the age of 7 cats are experiencing biological changes related to senescence. Cats aged 7-10 are ‘mature’, cats aged 11-14 are ‘senior’ and after 15 years of age, cats are considered to be ‘geriatric’ (1). For the purpose of simplicity, this lecture will refer to all three age groups as ‘senior’.

By the time a cat reaches it’s senior years, it is hopeful that we have established a good working relationship with our client over the years of the patient’s life. Clients recognize that their pet is getting old. However they do not always understand exactly what changes are going to occur and which of those changes are normal and which are a sign of disease or pain.

Clients usually have a good awareness of their cat’s normal behaviors and activities. As cats age, clients should consider starting some form of journal or notebook to highlight the normal patterns of behavior of their particular cat. Timing of eating, elimination behaviors, sleep, and play, when documented, will act as an excellent resource when attempting to identify changes.

A key behavior that is often excused as a normal part of aging is sleep. Cats living in confinement (indoors) sleep up to 19 hours per day (2). Cats do not normally sleep more merely as a consequence of aging. Sleep patterns include hours spent sleeping or resting, choice of location, and timing of sleep in a 24-hour period. Any changes noted in the normal sleeping patterns should act as an alert to the caregiver that something is not normal. Changes in normal sleep patterns may occur as a result of pain, nutrition imbalances, disease or cognitive dysfunction. Knowledge of all of the cat’s normal behavior patterns is a basic foundation for knowing when changes occur.

The subtle signs of sickness
Cats are masters at hiding illness. We understand and seek to help our clients recognize what subtle changes can mean with regard to feline health. In addition to being a sign of disease, we also have to recognize these subtle changes as evidence of possible pain.

The 10 subtle signs of sickness
1. Inappropriate Elimination Behavior or Litter Box Use
2. Changes in Interaction
3. Changes in Activity
4. Changes in Sleeping Habits
5. Changes in Food and Water Consumption
6. Unexplained Weight Loss or Gain
7. Changes in Grooming
8. Signs of Stress
9. Changes in Vocalization
10. Bad Breath

Senior and geriatric patients are at increased risk of disease in general. Risks of conditions such as chronic renal disease and hyperthyroidism are known to increase with age. Older patients are also at increased risk of neoplasia, hypertension, cardiac disease, osteoarthritis (OA) and/or degenerative joint disease (DJD). Dental disease and dental pain are common. Observations of unexplained changes in body weight, behavior, appetite, drinking, elimination behavior and grooming need to be addressed by the client and clinician in a timely fashion.

Pain
If cats are masters at hiding illness, they are geniuses at hiding pain. Caregivers frequently expect to see obvious, outward displays that would indicate pain in their cat, thus leaving them unable to perceive subtle changes suggestive of pain. Some clients may excuse away any changes, citing age as a factor. Monitoring normal patterns of behavior will help detect changes that may be occurring as a result of pain. The caregiver should monitor the cat’s mobility pattern and willingness to jump up or down. Lameness or signs of stiffness after rest should be noted. Changes in litter box usage and/or elimination patterns may be observed in painful cats. For example, cats with painful DJD may no longer consider it necessary to travel to a litter box located in the basement. They may instead elect to use an inappropriate area on the main floor of the house. Increased sleeping hours can be a big indicator of pain, as the cat becomes reluctant to move. Some cats may howl and meow abnormally at odd times during the day, particularly at night. Any or all of these signs can be due to pain, but may also overlap with diseased conditions as well as cognitive dysfunction. Clients should be encouraged to actually make notes about their cat’s activities and behaviors, especially as they age. This way, subtle and gradual changes will not be missed. In many cases, the best way to ascertain whether a cat is truly experiencing pain is to administer a 2-4 week analgesic trial.
**Body & muscle condition changes**

As cats age, changes in body weight, body condition and/or muscle condition can be the earliest signs noted that disease is present. Assessment and recording of body weight, body condition scoring (BCS) as well as muscle condition scoring (MCS) at every single veterinary visit is necessary to detect subtle changes early. As cats age, body muscling naturally changes. Cats will undergo decreases in muscling, a natural process referred to as sarcopenia. This needs to be distinguished from the more negative and often more rapid change cachexia. Cachexia can indicate the presence of disease, insufficient dietary needs and in particular, insufficient dietary protein. In addition to senior biannual examinations with the veterinarian, regular weigh-ins and BCS/MCS assessments with a registered veterinary technician will assist in early detection of changes in any of these parameters. The client can be taught how to assess these parameters at home as well, making them more aware of changes should they occur.

https://www.wsava.org/sites/default/files/Muscle%20condition%20score%20chart%20Cats.pdf
https://www.wsava.org/sites/default/files/Body%20condition%20score%20chart%20Cats.pdf

**Dietary needs**

As cats age, appetite will often diminish. Changes that may impact the aging cat’s appetite include diminished taste, smell and vision, dental disease, painful arthritis and cognitive changes. Treatable conditions should be addressed and adjustments made to improve intake in the home setting. Dental surgery should not be avoided on the basis of age. Safe general anesthesia of senior patients is possible, with the right care and attention.

As cats age, their caloric and nutritional needs change (1). Early on in the aging process, up to 11 years of age, a cat’s energy needs will decrease by 3% per year. However, at the age of 12 and up, the energy needs actually increase. As cats age, they become less efficient at digesting food. In particular, the digestion of fats and proteins may be impaired. Senior and geriatric feline patients can be susceptible to weight loss. Dietary palatability is a major concern in this age group, including ensuring that the patient is consuming sufficient calories to meet their metabolic energy requirements (MERs).

Daily dietary intake needs to be quantified by the client in detail. Metabolic energy requirements (MERs) need to be calculated often by the clinician or veterinary technician. Quantifying daily intake for cats is a critical piece of knowledge for clients with senior and geriatric cats, particularly when unexplained weight loss has been detected.

Intake can be improved in the home setting by offering smaller, more frequent meals of highly palatable, age-appropriate food. Slight warming of the food either with warm water or briefly in the microwave, will improve the smell and taste of the food. The client should ensure that the cat has easy access to the food bowls and that competition from other household cats or dogs is completely eliminated. Cats may be experiencing some cervical pain as a result of arthritis, or have neck weakness associated with disease. Feeding platforms raised to a comfortable height will be beneficial for these cats. Age-appropriate diets from a reputable pet food company are best chosen during the senior and geriatric years. Many generic and over the counter foods do not contain age-appropriate content with regard to calories, protein, phosphorus and other nutrients. In these cases, it is best to rely on companies that have a good nutrition research program with an excellent track record of developing diets based on high-level evidence-based medicine.

**Cognitive changes**

Behavioral problems in the geriatric cat may be explained by the presence of disease and pain. Treatment of the disease, and/or treatment of pain will often resolve behavioral changes. Howling may be observed in some cases of hyperthyroidism, as well as patients with hypertension. Changes in elimination, including soiling outside of the litter box can occur with conditions such as arthritis, diabetes mellitus, renal disease, lower urinary tract disease, hyperthyroidism and neoplasia. Pain can lead to many changes in behavior including, but not limited to, elimination issues, irritability, increased sleeping, howling, decreased grooming and decreased mobility. Regular clinical testing as well as pain management will help identify disease and pain-related causes of behavior changes. Analgesic trials lasting 2-4 weeks will help identify pain-related behaviors. Cats that are over 6 years of age have evidence of DJD in at least one joint (3), and as a result many should be on daily analgesics and OA/DJD therapeutics.

In some cases, cognitive dysfunction (CD) may be the primary source behind the behavior changes noted (4). Although there are no specific diagnostic criteria for CD in cats, ruling out other causes and treating for pain will help the clinician form a presumptive diagnosis. Cognitive dysfunction signs in cats can include disorientation (time or space), altered learning and memory, house soiling, altered interactions with the client, activity changes, sleep pattern changes, alterations in appetite, and/or decreased grooming (4). Vocalization may also occur. Once other conditions have been treated and/or ruled out, CD becomes a more likely diagnosis. There are no specific medications that have been appropriately tested and shown to benefit cats with CD (1, 4), but adjustment for behavior and addressing environmental needs can go a long way to improving the patient. Mental stimulation is a key component in the aging cat and in particular the cat with CD (4). Regular play, feeding puzzles and other games will keep the mind active and engaged, reducing random CD behaviors.
Unique environmental needs

Senior and geriatric cats have unique environmental needs. This mainly stems from their likely reduced mobility secondary to arthritis, as well as weakness due to sarcopenia and/or disease. Particular consideration should be given to resource management. Litter boxes should be placed throughout the house, on more than one level, to reduce the travel time required for a senior cat to get to the box. Multiple litter boxes will also reduce competition issues in multi-cat households. A high walled litter box may be viewed as a painful challenge to be avoided. Use of low entry or low walled, uncovered litter boxes is recommended. Food and water bowls should be placed strategically throughout the house. Competition for food intake and potential safety threats at mealtime should be eliminated. This can be accomplished by feeding the senior cat in a confined environment away from other cats, dogs and young children. Food bowl preferences should be considered. Some cats will prefer bowls, but others may prefer flat, open edged plates. Raised feeding surfaces may reduce discomfort in those cats with cervical arthritis pain or weakness from disease. Assistance with access to higher furniture such as beds and windowsills can be accomplished with steps or platforms to reduce necessary jumping heights. Aging cats still need to play. Diminished play activity should be viewed as a potential sign of pain requiring an analgesic trial of 2-4 weeks duration. Favorite toys and play activities may vary from day to day. Caregivers should offer options as needed. Toys and feeding games that stimulate mental activity are beneficial. Electronic games on tablets such as Friskies App for cats offer alternatives for mental stimulation. Rather than placing it in a bowl, simply hiding kibble throughout the house at mealtime can provide a unique hunting experience for any age cat.

End of life decision making

It is the clinician and veterinary team’s role to help the caregiver understand what is normal for their cat and how this normal changes with advancing age. Encouraging the caregiver to record their cat’s daily behaviors will improve the ability to identify diminishing quality of life. Knowing the level of changes that have occurred in behavior patterns over time help the client to come to terms with end-of-life decisions. Regular contact with the caregiver and patient through 2-3 health checkups per year as well as frequent weigh ins can improve the bond and trust between the client and the veterinary team. This type of regular care opens channels of communication necessary as quality of life diminishes and euthanasia decisions need to be made. Quality of life discussions are difficult at best, but they will be made easier by open relationships based on trust and mutual respect.

References


