Based on polling the participants, you’ll learn the indications for, and how to perform:

- Esophagostomy tube placement for intermittent and trickle feeding,
- Bone marrow aspiration
- Intraosseous catheterization
- Medial saphenous vein catheterization
- Urethral catheterization
- Intubation without a laryngoscope and (transoral) tracheal wash,
- Percutaneous keyhole renal biopsy,
- Sample collection for rectal cytology and *Tritrichomonas foetus* identification,
- Blood pressure measurement using different types of monitors.

We will also cover:

- How to determine caloric needs for nutritional support,
- How to determine subcutaneous fluid requirements and how administer daily fluids comfortably,
- How to improve client compliance for supportive nutrition and maintenance of hydration
Esophageal tube placement

Indications

Any patient with a catabolic illness or malabsorptive disease (e.g., neoplasia, chronic intestinal or pancreatic disease, moderate to severe renal insufficiency) as well as inappetent or anorectic cats (e.g., hepatic lipidosis, suffering from pain or having difficulty breathing) will benefit from having a large bore feeding tube in place to provide balanced nutrition. Additionally, for cats with conditions mechanically interfering with prehension of food or swallowing (oral, pharyngeal or esophageal problems) esophageal tube (e-tube) placement should be seriously considered.

Advantages

- Tubes are well tolerated by cats and they can eat with the tube in place.
- Diets that are nutritionally complete and balanced may be administered through large bore tubes. This includes commercial diets designed for tube or assisted (syringe) feeding as well as blenderized prescription or maintenance diets.
- Use and care of tubes is easy and readily learned by clients.
- Tubes may be left in place as short or as long as is warranted by the patient's condition. They may be removed at any time, within days of placement if the cat is eating readily or after 6-18 months.
- Removal is easy and does not require sedation or anaesthesia.
- Unlike gastrotomy tubes, there is no risk of peritonitis, does not require endoscope, an ELD devise or a laparotomy.
- Unlike pharyngostomy tubes, there is no risk of coughing, laryngospasm or aspiration.
- Unlike naso-esophageal (n-e) tubes, a wide variety of nutritionally balanced diets appropriate for feline nutrition may be used. The tube is not in the cat's range of vision and is better tolerated. It can also be maintained for a longer period than a n-e tube can be.
- No long-term complications (such as esophageal stricture or diverticulum, esophagitis, or subcutaneous cervical cellulitis) have been reported.

Potential complications

- A brief anaesthetic is required.
- The patient may remove the tube before it is warranted. It may, however, be readily replaced without further sedation once a stoma has formed. A local will be required to replace the purse-string suture and Chinese finger tie.
- If the tube end is too far distal and enters the lower esophageal sphincter, reflux esophagitis may be anticipated. Placement of the tip at the 9th rib will prevent this from occurring.
- Occasionally, a patient may vomit the tube. If it is bitten off and swallowed, it will need to be retrieved. If not bitten off, it can readily be removed and replaced, as above.
- E-tube placement is contraindicated in patients lacking esophageal motility, such as those with megaesophagus, or in those with pre-existing esophageal inflammation.

Supplies needed

- Size 16 or 14 Fr. Red rubber feeding tube or silicon e-tube (e.g., Mila)
- Clippers, blade, surgical scrub and alcohol
- Sterile gloves
- Sterile pack containing: curved, blunt-tipped forceps, scalpel, #10 blade, sterile 2X2 gauze swabs, needle driver, scissors, thumb forceps
- Surgical field drape and towel clamps
- 3-0 nylon suture with swedged on cutting needle
- Antiseptic ointment
- Bandage materials and swabs OR Kitty Kollar with protective pads (www.kittykollar.com)
- 6 cc syringe
- Multiple-use injection port
Preparation and procedure

1. Provide anaesthesia and place an endotracheal tube, maintaining anaesthesia using inhalant gas.
2. With the patient in right lateral recumbency, shave the mid cervical region of the left side of the neck from the angle of the mandible to the thoracic inlet.
3. Locate the jugular vein.
4. Surgically prepare the shaved area.
5. Measure and mark with a Sharpie pen the level of the tube so that the tip of the tube held against the body will lie at the 9th rib. Keep the tube in its sterile package until you are ready to mark it.
6. Slightly extend the neck.
7. Insert the curved forceps into the mouth turning the tips laterally so that they raise the skin of the neck midpoint of the prepared area. Avoid the jugular.
8. Palpate the tip of the forceps and, using a scalpel blade, make a nick over the parted tip. Gently push the tips through the skin (blunt dissection of the muscle and esophageal mucosa may be used) to grasp the tip of the marked tube.
9. Pull the tip of the tube orad so that it is outside of the mouth.
10. Release it from the forceps and turn the tube around so that it is turned back on itself, heading down the esophagus. Using your fingers, gently push the tube down the esophagus straightening out the curve so that it is going straight down the esophagus. When it is correctly in place, the tube outside the body will flip forward and you will be able to slide the tube easily in and (partly) out of the incision. (Do not pull it right out!)
11. Line the mark on the tube up with the skin so that the tip is at the 9th rib. Place a purse string suture leaving both ends of suture long. Using both long ends, place a Chinese finger tie to trap the tube in place. Trim the suture ends. Apply tissue glue to the suture pattern on the tube to help keep it from slipping.
12. Cut the long end of the tube (if using a red rubber tube) just to the point that is the right diameter for the injection port to fit. Fill tube with 3-6 cc of room or body temp water and cap tube with injection port.
13. Apply a small amount of antiseptic ointment (e.g., Betadine or Hibitane ointment) on a swab at the incision site. Wrap a gauze bandage (e.g., Kling) around the neck to hold the tube in place without bending it awkwardly. Cover with a layer of a self-adhering bandage (e.g., Vet Wrap) making a small incision in this layer to slide the tube through. Alternately, use a Kitty Kollar and the protective pad.
14. Congratulations! You are done and can recover the patient. (The first few tubes you place, you may wish to verify placement [esophageal, rather than tracheal; up to 9th rib and not into the stomach] radiographically.)

When the tube is no longer needed, simply cut the purse string suture and pull the tube out. Suturing the opening is not required; it will contract and epithelialize over 2-3 days.

Instructions on feeding are included in the lecture notes: Getting Calories in: Feeding the Inappetant or Anorectic Cat.

Trickle feeding

Calculate the number of calories needed per day and convert this to the number of milliliters of syringeable diet required/day. Divide this volume by two for a twelve-hour period. Place this 12-hour quantity into a used empty fluid bag via a 16G needle on a large syringe (e.g., 20 ml syringe). Fill the (used) IV line with the food and run either by gravity drip or as a calculated volume through a syringe pump at a set rate. If the food is stiff and difficult to syringe, warm the calculated volume in a bowl gently in the microwave until the fat softens adequately to be syringeable.

IMPORTANT: Discard the used bag after 12 hours and start the next feeding period with a new, used fluid bag and line. You would not leave food (meat) at room temperature and expect it to remain safe. ☹

KittyKollar: www.kittykollar.com/
Endotracheal tube placement, from: Ogilvie GK, Moore AS. Feline Oncology. Trenton, Veterinary Learning Systems. 2001, p 120.
Inappetence and anorexia are common problems in feline patients. Inadequate nutrient intake is, at best, detrimental and interferes with healing. At worst, it is life-threatening. Cats have only a limited ability to conserve body protein; this can result in negative nitrogen balance, protein: calorie malnutrition and deterioration of protective mechanisms impacting immunity, red cell hemoglobin content, muscle mass as well as the ability to repair tissues. Additionally, cats have limited storage of many other nutrients as well as a restricted ability to down-regulate numerous metabolic processes. Their design is best suited to eating multiple small meals per day, high in protein, and moderate in fat. Inappetence and anorexia should be dealt with promptly and adequately.

Meeting the patient’s nutritional needs is not a substitute for localizing the cause for this inappetence. It is, however, necessary and allows time to identify the cause. Providing nutrients may be the most challenging part of any therapeutic regimen, and recovery or attaining the best possible QOL in cats may depend on our ability to ensure optimal nutrition.

The first question that must be answered is: why has this cat stopped eating? Is it because of a loss in appetite or some other reason? Nausea may be of neurologic origin (e.g., vestibular disease or irritation of the chemoreceptor trigger zone or the vomiting center by inflammation, neoplasia or chemicals including metabolites or drugs). It may be a result of dehydration or may originate with GI inflammation for any reason (e.g., ileus, colitis, upper intestinal or gastric disease). However, decreased food intake may be due to other factors, such as dysphagia, pain (e.g., oral, dental, GI, multisystemic, etc.), dislike of the diet (e.g., boredom, altered palatability, spoilage), aversion, fear (e.g., environmental changes including those in the social demographics).

Nutritional support should be considered for the severely malnourished cat (20% weight loss, body condition score 1-2/9) or moderately malnourished (a 10% weight loss, BCS 3-4/9) who also have catabolic disease. Some cats will benefit from early intervention even at normal weight and condition if they suffer from advanced renal disease, hepatopathy, protein losing GI or glomerular disease, pancreatitis or bile duct obstruction.

Inappetent cats, and those not ingesting adequate protein, shift into a catabolic state. They are at risk for hepatic lipidosis, especially if ill and possibly at a greater risk if previously obese. Lipidosis is a disease of dysfunctional lipoprotein metabolism; it is important to calculate the daily caloric and protein requirements as part of the therapeutic plan. [Calories: 50 kcal/kg ideal BW/day; 4.5 g protein/kg ideal BW/day]. The diet needs to be balanced for energy (protein, fat, +/- carbohydrates), vitamins and minerals. It needs to be palatable taking the following four factors into account: texture, aroma, taste, and consistency. Bowls should be wide and flat to avoid interfering with whiskers. The environment should be non-threatening, so a hospital setting is especially off-putting. Feline facial pheromone may be beneficial to reduce stress.

Rehydration and correction of electrolyte imbalances are important but oft overlooked goals in the correction of inappetence and anorexia. Anti-emetics have a place if the cat is vomiting. In gastric-origin nausea, agents such as H2 antagonists, gastroprotectants, proton pump inhibitors or prostaglandin E agonists may be beneficial depending on the cause of the gastric upset.

Appetite stimulants including cyproheptadine (1 mg/cat PO BID), mirtazapine (1-2mg/cat PO q48h) may help jump-start a cat’s appetite, but keep track of total calories consumed. If a cat is eating but not enough, supportive feeding (assisted syringe feeding or tube feeding) must be considered. A cat eating small amounts of baby food will not meet his caloric needs until he eats 2-3 jars/day. Meat baby food is not balanced, but is sufficient for several weeks. There are several diets specifically designed for the assisted feeding of cats (Royal Canin Recovery, Hill’s a/d, Purina PVD CN, Eukanuba Maximum Calorie), liquid balanced enteral diets for cats (Clinicare, Rebound) Additionally, we can make a slurry from any canned food; blend with a liquid feline diet rather than water to minimize loss of calories.
There are several options for assisted feeding each with advantages and disadvantages. In general, the author starts with syringe assisted feeding until the cat is stable enough to allow the brief anaesthetic required for the placement of an esophageal tube. With concurrent liver disease, give three doses of Vitamin K1 (1.0 mg/kg q12h SC) prior to tube placement, biopsies or any other procedure that might result in bleeding. Placement of esophageal tubes is discussed elsewhere. The instrumentation for this procedure is very basic requiring only the following: 14-16 Fr red rubber feeding tube/urinary catheter, Carmalt or other long curved forceps, a scalpel blade, suture and bandaging materials and a multiple use injection port (prn adaptor).

Calculating how much to feed requires that you know the patient’s current weight as well as their healthy weight and the caloric densities (kcal/ml) of the diet you are intending to use (see Table 1). Use 50 kcal/kg as a rough guide to determine calories needed. Start by feeding 1/3-1/2 of the calories needed for the current, inappetant weight. On day two, feed 2/3-3/4 of this number and on day three, feed the full calories needed for the current weight. For weight gain, gradually increase to the calories needed for the cat’s healthy weight.

**Example:**

3.4 kg sick cat BCS 3/9, healthy weight 4.0 kg BCS 5/9
3.4 kg X 50 kcal/kg/day = 170 kcal by day 3
170 kcal = 81 ml Eukanuba Maximum Calorie

OR 131 ml of Hill’s a/d or Royal Canin Recovery or PVD CN

Day 1 feed 30-40 ml of Max Cal or 44-65 ml of the other diets
Day 2 feed 54-61 ml of Max Cal or 87-98 ml of the other diets
Day 3 feed 81 ml Max Cal or 131 ml of the other diets.

Once stable, gradually increase to meet caloric requirements for 4 kg healthy weight.
4 kg X 50 kcal/kg/day = 200 kcal (95 ml Max Cal vs.154 ml of the other diets).

With surgically placed tubes there is a delay in how quickly one can start to use them; with an esophageal tube only a 2-3 hour delay is required to ensure full recovery from anaesthesia whereas gastrostomy and jejunostomy tubes require a longer wait of 10-12 hours. Cats can eat with any of these tubes in place. It is recommended to avoid offering food for a week to reduce the likelihood of them developing aversion to the food offered. Once a cat is eating well with tube in place the question becomes when one can remove the tube. Weigh the cat and, as long as he/she is eating well, avoid using the tube (for nutrients) for a week then reweigh the kitty. If the weight is stable (or increased), then it is safe to remove the tube. Because of stoma formation (except nasoesophageal tubes), removal does not require anaesthesia. Remove the suture (purse-string or stay sutures) and pull the tube out. In the case of a gastrostomy tube, its bulb must be straightened out the bulb/balloon by inserting a straight probe through the tube while concurrently pulling the tube out. Suturing is not required for any of the skin openings. Cleanse minimal serous discharge that may occur for 2-3 days.

Feeding frequency: the number of feedings per day, (and hence intervals), is determined based on the volume of food tolerated per feeding. Start with 6 ml and increase by 6 ml increments to about 36-48 for most cats. In the uncommon case of the patient who cannot tolerate even 6 ml boluses despite antiemetic therapy (see Pancreatitis notes in these Proceedings), trickle feeding may be instituted. Trickle feeding is a technique in which liquefied food is syringed into an empty fluid bag and administered gravitationally or by pump assistance via an intravenous line attached to the large bore feeding tube or by use of a large syringe filled with food and syringe pump. Renew food and delivery tubing and syringe at 12-hour intervals to avoid bacterial contamination. A promotility agent may be warranted as well. A good client reference is the Animal Medical Center of Canberra’s website: [www.animalmedicalcentre.com.au](http://www.animalmedicalcentre.com.au) => Pet Health => Articles => Cats => Tube feeding.

The success of assisted feeding is measured objectively by weight gain. Subjective measures will include improved coat quality, increased energy, muscle recovery and innumerable other effects that the client will appreciate. An improved quality of life is the goal whether recovery form the underlying problem is possible or not.
Table 1: Caloric densities of convalescent diets, for calculating feeding volumes:
Clinicare™: 1 kcal/ml
Royal Canin/MediCal Recovery™: 1.04 kcal/ml
Hill’s a/d™: 1.17 kcal/ml
Purina PPVD CN™: 1.33 kcal/ml

EXAMPLE:
4.0kg sick cat BCS 3/9, healthy weight 4.5kg BCS 5/9
Using 70 kcal/kg/day → 315 kcal by day 3
315 kcal = 302ml of Royal Canin Recovery™,
269 ml of Hill’s a/d™,
236 ml of Purina PPVD CN™

Example, using PPVD CN, the most calorically dense:
Day 1 feed 80 ml
Day 2 feed 160 ml
Day 3 feed 236 ml

Blending a renal (or any other) diet with Clinicare will provide a higher caloric density than if water is used.

EXAMPLE with renal diets:
Clinicare: 1 kcal/ml
Purina PPVD NF: 1.3 kcal/ml before slurrying
• 1 can food = 156 ml = 203 kcal
• Add 156 ml Clinicare = 156 kcal
• 312 ml has 359 kcal = 1.15 kcal/ml
  – With 156 ml water, would be 0.65 kcal/ml
  – (312 ml has 203 kcal)

Hills k/d: 1.13 kcal/ml before slurrying
• 1 can food = 156 ml = 176 kcal
• Add 156 ml Clinicare = 156 kcal
• 312 ml has 332 kcal = 1.06 kcal/ml
  – With 156 ml water, would be 0.56 kcal/ml
  – (312 ml has 176 kcal)

Royal Canin Renal Support E: 1.09 kcal/ml before slurrying
• 1 can food = 156 ml = 170 kcal
• Add 156 ml Clinicare = 156 kcal
• 312 ml has 326 kcal = 1.04 kcal/ml
  – With 156 ml water, would be 0.55 kcal/ml
  – (312 ml has 170 kcal)

Please email me (hypurr@aol.com if you would like the video of how to place an e-tube or for the using a feeding tube video.

SUGGESTED READING
Hodshon B, Tobias K. Esophagostomy Feeding Tubes Clinicians Brief February 2014
(www.cliniciansbrief.com/article/esophagostomy-feeding-tubes)
Bone marrow aspiration and core biopsy

Indications
Information gained from performing a marrow aspirate is helpful in patients with any persistent “–penia” (non-regenerative anemia, neutropenia, thrombocytopenia) that cannot be explained. A decrease in cell number occurs when one of the following three scenarios occurs:

1. decreased production and impaired maturation (marrow)
2. impaired cell release into circulation (marrow-vascular interface)
3. increased cell use/loss (tissues and/or vascular compartment: inflammation, infection, sequestration, blood loss)

Thus, when the third possibility has been ruled out or when lymphoma or myeloma are possibilities, a marrow tap should be considered. This is an underutilized procedure that is easy to perform and provides clinically relevant information. In addition to evaluating cells, marrow cytology also can be used to assess iron stores, infectious agents (e.g., Ehrlichia, Leishmania, Histoplasma, IFA or FeLV).

Potential complications
Use of local along with general anaesthesia is essential as the periosteum is highly innervated. Short term, post procedural analgesia may also be considered and the patient should be evaluated for evidence of discomfort. Patients with thrombocytopenia could potentially have bleeding problems subsequent to the procedure.

Supplies needed
- Clippers, blade, surgical scrub and alcohol
- Syringe with 2% lidocaine or Carbocaine V (0.5 ml)
- Sterile gloves
- 16G Jamshidi bone marrow, or 16G hypodermic needle
- Scalpel blade, #10 or 11
- Surgical field drape and towel clamps
- 12 cc syringe
- Sterile EDTA tube, red top tube with formalin, microscope slides

Preparation and procedure
1. Provide anaesthesia and place an endotracheal tube, maintaining anaesthesia using inhalant gas.
2. Shave ~ 4X4 cm area at the chosen site: sites commonly used for this procedure in the cat are the femur, the humerus and the wing of the ileum. The description that follows is for use of the greater trochanter of the femur.
3. Surgically prepare the shaved area.
4. Infiltrate the area subcutaneous tissues and the periosteum with 0.5 ml of 2% lidocaine or Carbocaine V.
5. Repeat the surgical preparation.
6. With the help of an assistant, drape the leg leaving the hip (and the head of the femur) exposed.
7. Holding the draped thigh in one hand, palpate the greater trochanter and the trochanteric fossa with the other. Hold the leg in adduction to avoid the sciatic nerve. Using the scalpel blade, make a stab incision at this site.
8. Insert the Jamshidi or hypodermic needle through the stab incision to abut against the bone of the trochanteric fossa directing it lengthwise so that it will enter the femoral cavity.
9. Rotate the needle with enough pressure that it penetrates the cortex in the direction of the length of the femur. When the needle is properly seated, moving it cranio-caudally will move the entire leg in the same direction.
10. Remove the stylet if using a Jamshidi device.
11. Place a sterile 12 ml syringe on the needle and aspirate with 3-4 ml of pressure, 1-5 times until a small amount of marrow appears in the hub or tip of the syringe.
12. (If using a 16G hypodermic needle, you may find that the needle is plugged. In this case, remove the needle and replace with a new one. Eject the plug of bone into the formalin filled red top tube.)
13. Quickly remove the needle (either type) from the syringe and make 4-6 cytology slides: place a large drop
of blood, tilting it so that the blood moves away from the bone spicules. Using a second slide
perpendicular to the first, gently draw them apart to make the prep.
14. Place remaining marrow in an EDTA tube.
15. Ideally you will also have a bone core to submit for histopathology.
16. Submit a peripheral blood sample for a CBC with differential (another EDTA tube and blood films)
concurrently in order to assess release of cells from the marrow into circulation.

Bone marrow aspiration sites, from: Ogilvie GK, Moore AS. Feline Oncology. Trenton, Veterinary Learning Systems.
2001, p 27.

A useful website is: http://www.vetmed.wsu.edu/resources/techniques/bm.aspx
Intraosseous catheter placement

Indications
Intraosseous catheterization is a rapid and effective alternative to venous access in patients who are either too small or too shocky to place an IV catheter in. This route may be used to deliver crystalloids, colloids, blood products and any medication that can be given IV. Absorption into circulation is brisk. In human patients, this procedure is preferred when time is critical, e.g., in war trauma. This route is not suitable for sampling blood, however. In general, once the patient is stable enough and has adequate blood pressure, the IO catheter is replaced with an IV catheter.

Potential complications
Use of a device (such as a hypodermic needle) lacking a stylet (such as a Jamshidi or spinal needle) may result in difficulty due to a bone core plugging the lumen.

Supplies needed
- Clippers, blade, surgical scrub and alcohol
- 2% lidocaine or Carbocaine V (0.5 ml)
- Sterile gloves
- 16-18G bone marrow needle or an 18-22G spinal needle
- Syringe with 2% lidocaine or Carbocaine V (0.5 ml) and a 22-25G needle
- Heparinized saline flush
- Betadine or Hibitane ointment
- Bandaging materials
- Multiple-use injection port

Preparation and procedure
1. Place patient in lateral recumbency and restrain as necessary
2. Shave a 4X4cm area over the region of the greater trochanter of the femur
3. Surgically prepare the shaved area.
4. Infiltrate the area subcutaneous tissues and the periosteum with 0.5 ml of 2% lidocaine or Carbocaine V.
5. Palpate the greater trochanter and the trochanteric fossa.
6. Hold the leg in adduction to avoid the sciatic nerve, advance the needle and stylet through the skin to the trochanteric fossa in the direction of the length of the femur.
7. Rotate the needle with enough pressure that it penetrates the cortex. When the needle is properly seated, moving it cranio-caudally will move the entire leg in the same direction.
8. Remove the stylet and attach a syringe containing heparinized saline to the needle.
9. Flush the heparinized saline into the marrow cavity. If placed properly, the saline will flow without resistance. Palpate the femur simultaneously: swelling along the shaft of the femur indicates that the catheter has penetrated the femoral cortex distally.
10. Cap the catheter with a multiple-use injection port.
11. Bandage the site to secure the catheter and to keep the area clean.
Urethral catheterization

Indications
Obstruction of urethral flow may be caused by intraluminal material, (e.g., crystals or a plug), or by narrowing of the lumen due to mural thickening, (e.g., inflammation or neoplasia), Functional impairment (spasm from pain) or compression of the urethra by something external, but adjacent to the urethra (e.g., prostatic disease, mass in caudal abdomen or pelvic abdomen, severe obstipation, painful anal sac disease). Additionally, anything acting like a ball valve in the bladder (polyp, tumour, stone) will prevent its emptying. Regardless of cause, the resulting retention of urine needs to be relieved.

The patient must be stable enough as the anaesthetic may be lengthy while unblocking the bladder. As a result, therapeutic/decompressive cystocentesis should be performed immediately. The cat should receive analgesics and be started on IV fluids to help correct electrolyte imbalances. These therapies should be performed before anaesthesia and unblocking the patient.

Potential complications
Inadvertent trauma to the urethral walls caused by catheterization may result in permanent stricture or perforation of the urethra with resultant peritonitis. Gentle, persistent, handling of minimally traumatic and lubricated catheters will help to prevent the former.

Bacterial cystitis or pyelonephritis may result from the introduction of bacteria that may be capable of colonizing in the compromised organ. As a consequence, utmost care needs to be taken in cleaning the perineal area; handle all materials in as sterile a fashion as is possible and maintain the catheter as a closed collection system.

Supplies needed
- Opioid, sedative, IV catheter, IV fluids, 6 ml syringe + 22 or 25G needle, IV extension set, 3-way stop cock, bowl
- Clippers, blade, surgical scrub and alcohol
- Lidocaine gel
- Sterile gloves
- Otoscope
- Slippery Sam open-ended urethral catheters
  - or rigid open-ended tomcat catheter + red rubber feeding tube side-opening: 3 Fr
  - or Mila urinary catheter: 3.5 Fr X 10"
- Needle driver
- Suture material
- Adhesive tape: 1/2” and 1” wide
- Used, empty IV fluid bag + IV admin set

Preparation and procedure
1. Reduce bladder size/urine volume by performing decompressive cystocentesis using a 25 or 22 G needle on an extension set and aspirating as much urine as possible. Be sure to keep the tip of the needle inside the bladder. Save some of the cystocentesis collected urine for urinalysis setting aside a volume in a sterile red top tube and on culturette medium in case culture is indicated (based on the results of the U/A). Using a 3-way stop cock on the extension set is tidier than repeatedly disengaging and reattaching the syringe to the open extension set, however is not necessary.
2. Administer analgesia (e.g., buprenorphine or hydromorphone) + sedation IM or IV +/- a single low dose of an NSAID
3. Place IV catheter and start IV fluids
MALE CAT

4. Place the sedated patient in one of the following positions:
   a. on his back with his back legs held up and pulled toward the head by an assistant, or
   b. in lateral recumbency with an assistant holding the top leg pulled toward the head

5. Gently clean the perineal area with surgical scrub, rinsing well with warm water.

6. Wearing an exam glove, rectal massage of the pelvic urethra may help to dislodge an intraluminal obstruction. Palpate to evaluate for extra-urethral masses as well as the size of the prostate.

7. Extrude the penis by applying pressure on the prepuce; examine it to see if it is bruised or if there is a plug of crystalline material at its tip that may be readily removed.

8. Use a well-lubricated (lidocaine gel) rigid, open-ended (Minnesota olive-tip) catheter initially. Flush the catheter with bursts of saline +/- saline mixed with ordinary KY-like lube.

9. If you are having difficulty passing the catheter, it may help to have an assistant gently press down on the urethra digitally, per rectum. This helps to reduce the angle of the urethra as it passes over the pelvic brim. If there is a stone in the urethra, apply digital pressure to the urethra proximal to the obstruction and flush to dilate the urethra. Because of digital compression, the urethra will dilate around the stone so that when the finger is lifted, the stone can be flushed into the bladder.

10. Advance the catheter into the bladder to drain the urine. Lavage with sterile saline until the resulting drained fluid is clear.

11. Gently replace this stiff catheter with a lubricated soft Slippery Sam, Mila or red rubber feeding tube and attach to an empty IV admin set/line to make a closed urine collection system. Be sure to check that the thumb roller and any other clip or clamp on the line is opened!

12. Affix the catheter by suturing a wing device (1/2 “ tape or manufactured wings) to the perineal skin.

13. Make sure that the collection line does not drag on the catheter by taping a loop of it (1” tape) to the tail. Lay the bag lower than the cat, i.e., hang on the cage door lower than the floor of the kennel or lay it on the cage floor.

14. Empty and measure the urine at least twice a day and record volume and character in the medical record.

15. Use anti-spasmodic drugs to relieve both the striated sphincter (diazepam 1-2.5 mg PO q8-12h) and smooth muscle sphincter (phenoxybenzamine 2.5-7.5 mg PO q8-12h) while the catheter is in place and continuing for ~ 5 days after its removal. If the cat was blocked for long enough that the bladder smooth muscle junctions were damaged resulting in atony, then bethanechol (1.25-7.5 mg PO q8-12h) should be added and continued until the cat is able to fully empty his bladder after voiding.

16. At the time of removal, collect urine directly from the catheter for culture and sensitivity.
Images Courtesy of Danielle Gunn-Moore
FEMALE CAT

4. Place the sedated patient in sternal recumbency with her hind legs pulled forward. Have an assistant hold the tail vertically.

5. Gently clean the perineal area with surgical scrub, rinsing well with warm water.

6. Wearing sterile gloves gently grasp the ventral portion of the vulva and pull caudally. This will open the vaginal vault.

7. Gently guide a well lubricated 3.5 Fr close-ended catheter over the clitoral fossa along the vaginal floor until the tip of the catheter slips into the urethral opening. You can use your smallest finger in the vagina as a guide by passing the catheter underneath your finger. Visualization is generally not needed, but if you wish, you can use an otoscope to illuminate the vault.

8. Gently pass the catheter forward until urine is obtained or you meet resistance.

9. If you are having difficulty passing the catheter, it may help to have an assistant gently press down on the urethra digitally, per rectum. This helps to reduce the angle of the urethra as it passes over the pelvic brim. If there is a stone in the urethra, apply digital pressure to the urethra proximal to the obstruction and flush to dilate the urethra. Because of digital compression, the urethra will dilate around the stone so that when the finger is lifted, the stone can be flushed into the bladder.

10. Advance the catheter into the bladder to drain the urine. Lavage with sterile saline until the resulting drained fluid is clear.

11. Replace the stiff catheter with a 3.5 Fr feeding tube or Mila tube and attach the catheter to an empty IV admin set/line and bag to make a closed urine collection system. Be sure to check that the thumb roller and any other clip or clamp on the line is opened!

12. Affix the catheter by suturing a wing device (1/2” tape or manufactured wings) to the skin lateral to the vulva.

13. Make sure that the collection line does not drag on the catheter by taping a loop of it (1” tape) to the tail. Lay the bag lower than the cat, i.e., hang on the cage door lower than the floor of the kennel or lay it on the cage floor.

14. Empty and measure the urine at least twice a day and record volume and character in the medical record.

15. Use anti-spasmodic drugs to relieve both the striated sphincter (diazepam 1-2.5 mg PO q8-12h) and smooth muscle sphincter (phenoxybenzamine 2.5-7.5 mg PO q8-12h) while the catheter is in place and continuing for ~ 5 days after its removal. If the cat was blocked for long enough that the bladder smooth muscle junctions were damaged resulting in atony, then bethanechol (1.25-7.5 mg PO q8-12h) should be added and continued until the cat is able to fully empty his bladder after voiding.

16. At the time of removal, collect urine directly from the catheter for culture and sensitivity.
**Intubation without a laryngoscope**

**Indications**

Intubation without a laryngoscope is easier and is less cumbersome. Some people are able to perform this without the aid of an assistant.

**Supplies needed**

- A selection of cuffed endotracheal tubes: Sizes 2.5, 3.0, 3.5, 4.0 and 4.5 will fit cats with 3.0, 3.5 and 4.0 being appropriate for the majority of cats.
- An empty 3 cc syringe for air insufflation into the cuff
- Several 2X2 gauze swabs
- A plastic string tie or umbilical tape to tie the tube in place (~ 12” long)
- KY or other water soluble lubricant or lidocaine gel
- A tuberculin syringe with 0.5 ml 2% lidocaine with a blunt ended needle

**Preparation and procedure**

1. Verify that the endotracheal tube to be used is free from any internal obstruction from previous use and that the cuff is flat (un-inflated).
2. After administration of pre-medication and induction of anaesthesia, the patient is placed in sternal recumbency with her front limbs hanging over the table edge.
3. The assistant stands beside/behind the cat and holds the patient’s mouth open with one hand (hand over head, fingers at angle of jaw), she/he pulls the skin over the larynx rostrally.
4. The person intubating gently grasps the tongue with a swab and pulls it forward (rostrally) to expose the laryngeal folds. Numb this region with 0.1-0.3 ml of lidocaine.
5. With the tongue still pulled forward, you should be able to clearly visualize the opening. Grasp the well-lubricated endotracheal tube and aim it towards the opening between the arytenoid cartilages. If touching this area causes them to close, back the tube up very slightly just so that it isn’t touching the tissue and wait. Listening for airflow through the tube is also helpful to determine when to advance the tube. Momentarily, the folds will open allowing you to slide the tube past them.
6. Aspirate to check that you get air back from the tube indicating that the tube is in the trachea rather than the esophagus.
7. Dispose of the tongue swab.
8. Tie the tube around the cat’s head with a disposable tie.
9. Gently apply air into the cuff checking that there is some “give” in order to avoid over inflation.
10. Attach endotracheal tube to inhalant anaesthetic line.
Tracheal wash: transoral technique/blind bronchoalveolar lavage

Indications
Bronchopulmonary disease diagnostics requires the harvesting of airway secretions for cytologic and microbiologic evaluation analysis for differentiation and diagnosis of the various causes of coughing and/or wheezing in the cat. Tracheal wash is easy to perform and is available to all practitioners. The transoral technique is less traumatic than the transtracheal approach. Thoracic radiographs are taken in order to aid in patient selection. Cats with cardiogenic pulmonary edema or effusive disease of any cause, evidence of coagulopathy or thoracic trauma are not candidates for this procedure. In addition to inducing undue risk for a cardiovascularly unstable patient, tracheal wash will not provide useful information. Most changes in the interstitium will not be sampled using this technique with the exception of mycotic and possibly neoplastic disease. Cats with bronchial &/or alveolar pattern are the main candidates for tracheal wash. Laryngeal function is also evaluated in the intubation phase of this procedure.

Macrophages may represent up to 70% of the cells in healthy cats. The majority of the cells in BAL samples from cats with bronchopulmonary disease are either neutrophils, eosinophils or macrophages. The numbers and proportions vary in sick cats; this may represent a continuum of condition. The presence of alveolar macrophages is proof of sampling from lower airways. If intracellular bacteria are seen and a gram stain supports the presence of bacteria, then a culture and sensitivity should be run. Cultures are often negative in bronchopneumonia. The role and significance of Mycoplasma and Bordetella remains to be determined.

Potential complications
Care must be taken in order to minimize the chance of oropharyngeal contamination of the sample. Should oropharyngeal contamination occur, it will be noted by the pathologist; it is characterized by the presence of Simonsiella organisms (bacteria that look like a stack of coins) or squamous epithelial cells. Transtracheal technique avoids the mouth, thereby eliminating the possibility of this contamination. Bronchoalveolar lavage (requiring bronchoscopy) allows exact placement of the scope and delivery of flushing agent to a specific region of concern.

All three techniques require anaesthesia, a risk factor in a severely compromised patient, however, provision of an open airway (endotracheal tube) and oxygen reduces risk during the procedure. Pre-oxygenation is also helpful. A dose of terbutaline (0.01 mg/kg ideal weight) SC, IM at the time of premed may help by causing bronchodilation. Additionally, once the airways have been flushed, removing mucoid or other debris, the patient appears to breathe better for a period of time.

Supplies needed
- Sterile 5 Fr red rubber feeding tube in packaging
- Sterile endotracheal tubes, size 3, 3.5 and 4.0
- An empty 3 cc syringe for air insufflation into the cuff
- Several 2X2 gauze swabs
- A plastic string tie or umbilical tape to tie the tube in place (~ 12” long)
- KY or other water soluble lubricant or lidocaine gel
- A tuberculin syringe with 0.5 ml 2% lidocaine with a blunt ended needle
- Sterile 0.9% saline
- Glass microscope slides (6-10, slide mailers
- Sterile EDTA tube
- Sterile red top tube
- Culturette tube

Preparation and procedure
1. Administer premed and pre-oxygenate for 3-5 minutes.
2. Administer terbutaline (0.01 mg/kg ideal weight) SC, IM at the time of premed.
3. Place IV catheter and induce anaesthesia.
4. Using a sterile and well-rinsed or sterile new endotracheal tube, intubate the patient as above being sure to observe laryngeal function.
5. When passing this sterile endotracheal tube, be careful to not touch the tongue or other oral surfaces.
6. The cat should not be too deep; he/she should retain a cough reflex.
7. Keeping the patient in sternal positioning, pass a 5 Fr. red rubber feeding tube through an opening made in the end of its packaging, through the endotracheal tube until slight resistance is met.
8. Flush a 6 ml aliquot of non-bacteriostatic physiologic sterile saline and aspirate the wash back into a sterile collection syringe. You will only get 1-2 ml back.
9. Repeat this procedure so that 12 mls of saline have flushed the airways.
10. Administering chest coupage to the lateral chest walls may help loosen material.
11. Remove the red rubber feeding tube.
12. Make slides immediately from the harvested fluid. Submit the remainder in an EDTA tube saving a small amount for a sterile red top tube to be used on the Culturette for culture should the fluid cytology show significant organisms.
13. Administer oxygen through the endotracheal tube until the patient is ready to be extubated.
**Percutaneous keyhole renal biopsy**

**Indications**

A renal biopsy is indicated only if the results of the biopsy may provide clinically useful information (e.g., acute renal failure (ARF), glomerulonephritis (GN)). Histopathology may help in ARF by determining cause and extent and in GN, the type and distribution of lesion; in both cases, this information helps with the treatment of the disease.

**Potential complications**

- A brief anaesthetic is required.
- The first of two major considerations is reduction in kidney mass if the angle that the biopsy is harvested is incorrect so that medulla is biopsied rather than cortex alone.
- The other main concern is bleeding, thus a patient with a known bleeding disorder, on medications that interfere with platelet function (e.g., ASA, Adequan) is not a suitable candidate for renal biopsy.
- Of lesser consideration only because it is not life threatening, is pain. A patient who undergoes renal biopsy should receive adequate multimodal analgesia preemptively, as well as post-operatively. Should the procedure be done under sedation (not recommended) rather than a full general anaesthesia, then analgesia must be provided at that time.

**Supplies needed**

- Clippers, blade, surgical scrub and alcohol
- Sterile gloves
- Sterile pack containing: curved, blunt-tipped forceps, mosquito forceps, scalpel, #10 blade, sterile 2X2 gauze swabs, needle driver, scissors, thumb forceps
- Surgical field drape and towel clamps
- Tru-cut biopsy device 11 mm, 7 mm specimen notch, 18G needle
- 4-0 absorbable (Monocryl) suture with swedged on 3/8 circle taper needle
- 3-0 nylon suture with swedged on cutting needle
- saline in a wash bottle or syringe
- plastic ruler

**Preparation and procedure**

To warrant this procedure, tissue samples must be submitted to individuals with expertise in nephropathology who are able to use all methods necessary to optimally characterize the lesions in order to generate clinically meaningful information. Contact and speak with the individual who will be evaluating the tissue sample to obtain complete instructions and ensure that you feel comfortable with the technique before proceeding.

**International Veterinary Renal Pathology Service**
Ohio State University + Texas A&M University
www.pathology.osu.edu

Biopsies can be done either: 1. using an automated needle biopsy device and ultrasound guidance or 2. via a surgical approach (key hole needle or wedge biopsies or via laparotomy. All techniques require that the patient be anaesthetized rather than sedated for comfort and for immobilization. Ultrasound guided needle biopsy is appropriate when the expected lesions are diffusely distributed in the cortex (e.g., ARF, GN). With experience, this approach is less traumatic for the patient than the surgical options may be and can yield adequate to excellent samples. Extensive practice in aspiration and biopsy of other organs is urged before attempting this procedure as there is little room for error. We will be using the keyhole approach in this lab.
Restrict the area of biopsy interest to the cortex to avoid penetrating the medulla accidentally and because the conditions of interest are found in the cortex.

1. Provide anaesthesia and place an endotracheal tube, maintaining anaesthesia using inhalant gas.
2. With the patient in sternal recumbency, shave over the kidney to be biopsied.
3. Surgically prepare the shaved area.

WEDGE BIOPSY
4. Make a small keyhole incision over the kidney (or a celiotomy/laparotomy may be performed).
5. As it is too easy to penetrate too deeply without the benefit of ultrasound to visualize the difference between the cortical and medullary echos, a wedge biopsy is preferable to using the automated needle biopsy device.
6. Make an incision into the cortex of the kidney using a #15 scalpel blade. Make another incision to obtain a wedge-shaped section of cortex cutting it off with a flat bottom before the medulla is penetrated. Suture the wound closed using 4-0 or 3-0 Monocryl on a taper needle. A mattress pattern provides a secure closure in a rather delicate capsule. To keep from tearing the suture out of the capsule, place the entire length of suture through the first bite before taking the second or return bite. The first throw of the knot can be a surgeon’s knot and should be tied slowly to prevent tearing. One or two mattress sutures may be needed to complete the closure, depending on the size of the biopsy.
7. The wedge can then be subdivided into samples as recommended by the personnel at the renal pathology center.
8. **Always keep the tissue cores moist on saline soaked swabs. Never handle them with toothed-forceps. Place them into the appropriate preservative and fixatives promptly as per directions provided by the renal pathology service.**
9. Close the skin with 3-0 nylon.

TRU-CUT BIOPSY
4. Make a small stab incision with a scalpel blade through the skin. Advance the biopsy needle through the body wall up to and just through the capsule before activating the biopsy device. Cock the biopsy needle by withdrawing the handle until the obturator specimen rod is fully distended. Place the tip of the specimen rod on the kidney capsule and direct it to sample the outer one-third of the kidney in a direction parallel to the longitudinal axis of the kidney. Push the obturator rod into the kidney to the depth desired or until the outer cannula is contacted by the renal capsule. Pressing on the handle fires the needle
driving the outer cannula over the obturator specimen rod and securing the sample. Withdraw the needle. SLOWLY open the biopsy chamber once again by cocking the mechanism.

5. Harvest a minimum of two cortical core samples. (Ideal samples are > 10 mm in length.) If they are shorter than this, collect a third tissue core. Use a gentle flow of sterile saline through a 25G needle to flush the tissue from the biopsy needle onto a glass slide to keep the biopsy needle sterile for the next sample and to avoid traumatizing the sample.

6. Flush the biopsy needle with more saline and greater force (away from the sample) to dislodge any debris remaining in the cutting channel. Repeat until two-three good cores have been collected. Check that the samples contain glomeruli using the 10-40X lens on a microscope or a handheld magnifying lens or an ocular loupe.

7. Place pressure on the biopsy site until bleeding stops. In some cases, the wound may need to be closed with a single simple interrupted suture of 4-0 Monocryl or PDS.

8. **Always keep the tissue cores moist on saline soaked swabs. Never handle them with toothed-forceps.** Place them into the appropriate preservative and fixatives promptly as per directions provided by the renal pathology service.

9. Close the skin with 3-0 nylon.

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**Rectal cytology and *Tritrichomonas foetus***

For large bowel diarrhea, cytology from rectal scrapings and gram stain of prepared slides may be very helpful in achieving a definitive diagnosis in many cases of large bowel diarrhea. This test harvests cells and organisms from the lumen-colon wall interface. Insert a moistened sterile culture swab 2-3 cm into the rectum of the cat and rotate it gently. Roll this swab gently and thoroughly on two microscope slides and store the swab in the culturette medium. Submit the slides for cytology plus gram stain and follow with the swab as indicated by the cytology results. Rectal cytology may diagnose bacterial or non-septic suppurative colitis, Cryptosporidium, Giardia, Tritrichomonas, Campylobacter infections as well as fungal hyphae. The presence of clostridial spores must be interpreted carefully and a fecal enterotoxin assay should be performed to determine if disease-causing clostridial enterotoxin is present or not.

*Trichomonas foetus* may be identified with light microscopy as a motile flagellated organism, which looks similar to *Giardia*. A commercially available test, (InPouch Feline TF®) has been validated as an excellent way to specifically identify this organism and is sensitive and specific for detection of *T. foetus* in feline feces. Inoculate a pouch with 0.025-0.05g of fresh feces (peppercorn or grain of rice size), then incubate it standing upright, at room temperature (optimally 25°C), in the dark and examine the pouch for trophozoites at 20X every other day for 12 days. Approximately 50% of infected samples tested will be positive in three days. Light microscopy (on either a wet mount or rectal cytology), InPouch culture (or modified Diamond culture in commercial laboratory) may result in false negative results. A third type of test, PCR for *Trichomonas* may be submitted to the appropriate facility. It is more sensitive and exquisitely specific and is the gold standard; it may also occasionally fail to detect the organism in an affected cat.

Fecal culture may be considered when specific pathogens are to be investigated. Routine culturing will give results that are difficult to interpret and is not recommended. Growth of *Salmonella*, *Campylobacter* sp., or *Clostridium* sp. may be attempted on specific culture media when these agents are suspected, such as in an acute (or recurrent) outbreak of diarrhea after showing or in multiple cats in a household.