FELINE MEDICINE

by

Cynthia Stubbs, DVM, MS, DACVIM

December 12, 2007
Focus on Feline Medicine:
Providing the best medical care

My perspective—I am an internist in private practice. Because I am not associated with a university or large referral hospital, I have a better understanding of real life in a veterinary practice. My job as a veterinarian is to make medical care recommendations based on what the patient needs. The following is my opinion regarding what I believe to be an ideal health care program for cats of all ages, even before they develop the chronic illnesses that I typically deal with. With a program like this in place, I believe you can help these cats achieve a longer, higher-quality of life. As you develop or modify a comprehensive feline health care program for your practice, be sure to include all your employees in the implementation of the plan. Make it easy, make it clear and most of all, be consistent with the program.

Kittens – Birth to one year of age

You will see the new kitten often during this first year of life. Each visit is an opportunity to educate the client on the type of care that you believe is best for that kitten. Remember, the client is at your hospital wanting your advice.

What does my kitten need?

Comprehensive health care program for kittens:
- Routine wellness examinations
- Viral testing (FeLV/FIV) once
- Parasite exam
- Heartworm testing/preventative
- Vaccinations based on individual kitten’s need/environment
- Baseline bloodwork and urine tests (usually preanesthetic evaluation)
- ECG and blood pressure prior to anesthesia
- Spay/neuter surgery at appropriate age

Focus on education of client regarding pet’s needs—Feline behavior, dental care, dietary counseling/exercise, and individualized parasite control programs. Handouts are helpful to the client. Your recommendations should be echoed by all employees.

Adult cats (healthy) – One to seven years of age

This cat will visit your office twice a year. Since the pet is apparently healthy, the client may not be aware of health risks and the importance of detecting disease at an early stage (before signs of illness).
Comprehensive health care program for adult cats (healthy):
- Obtain an updated medical & behavioral history at each visit
- Routine wellness examinations – twice a year
- Viral testing (new patients)
- Parasite exam - yearly
- Heartworm testing/preventative – yearly
- Review vaccinations needs
- Bloodwork and urine tests – yearly or prior to any procedure requiring anesthesia
- Blood pressure measurement – yearly or prior to any procedure requiring anesthesia
- ECG – yearly or prior to any procedure requiring anesthesia
- Dental cleaning and polishing when needed
- Focus on education of client regarding pet’s needs

**Senior cats (healthy) – Seven years of age plus**

This cat will visit your office twice a year. The client is probably more aware of health risks as the pet ages, but may be unsure what those risks are and what age is considered “senior.”

Comprehensive health care program for senior cats (healthy)
- Obtain an updated medical & behavioral history at each visit
- Routine wellness examinations – twice a year
- Viral testing (new patients)
- Parasite exam - yearly
- Heartworm testing/preventative – yearly
- Review vaccinations needs
- Bloodwork and urine tests – every 6 months and prior to any procedure requiring anesthesia
- Blood pressure measurement – every 6 months and prior to any procedure requiring anesthesia
- ECG – yearly and prior to any procedure requiring anesthesia
- Dental cleaning and polishing when needed
- Focus on education of client regarding pet’s needs

**Adult and senior cats with clinical signs of disease**

This cat will visit your office more often because the client is aware that there is a problem. You need to clearly educate the client about the type of medical care the pet needs to correct or delay the progression of disease while improving or maintaining residual function. Clients desire a good quality of life for their cats. Give the clients the information they seek so they can make informed decisions regarding their cats’ medical care. Your staff should also be educated about the medical care you are recommending. Be consistent.
Comprehensive health care program for cats with clinical signs of disease:

Obtain an updated medical & behavioral history at each visit
Routine wellness examinations – every 3-6 months, or more often depending on the cat’s condition
Viral testing – retest cats with chronic illnesses/non-responders
Parasite exam – yearly
Heartworm testing/preventative - yearly
Vaccinations – not a priority at this time but review risk factors.
Bloodwork and urine tests – as indicated by the cat’s condition but at least every 3-6 months.
Blood pressure measurement – as needed but at least every 6 months.
ECG – as needed but at least every 6 months.
Dental cleaning and polishing when needed
Focus on education of client regarding pet’s needs

**Blood Pressure Measurement**

High blood pressure is a common complication of many diseases we diagnose in our feline patients. Some of these diseases are:

- Hyperthyroidism
- Diabetes mellitus
- Renal, hepatic, and cardiac insufficiency
- Hyperadrenocorticism
- Obesity
- Neoplasia – pheochromocytoma; mineralocorticoid-secreting tumor (primary hyperaldosteronism)

Some of the drugs and nutraceuticals used can cause high blood pressure:

- Drugs – phenylpropanolamine (PPA), phenylephrine, theophylline, aminophylline
- Supplements – Ma huang (Ephedra sinica)

The time to diagnose high blood pressure is before damage is done. Retinal hemorrhages and detachment can be avoided in a well-managed feline patient. I recommend that Doppler ultrasonic blood pressure measurements begin in all patients at an early age as part of their health care program. That helps the veterinarian establish a baseline for each individual cat. Senior cats, which have a greater risk of developing diseases that cause high blood pressure, should have their blood pressure checked every 6 months. Once a cat has been diagnosed with a disease that can cause high blood pressure (ex: CRF), blood pressure measurements should occur at least every 3 months or sooner if any concerns arise. High blood pressure can be a silent killer. Your clients are well educated about high blood pressure, so it is easy for them to understand the importance of blood pressure control in their cats.

Normal blood pressure measurement: 145 mmHg or less (systolic reading)

**Drug therapy:**

- Amlodipine 0.625 – 1.25 mg/cat once daily
- Enalapril 0.25 - 0.5 mg/kg q 12-24 h
- Benazapril 0.25-0.5 mg/kg q 12-24 h
- Atenolol 6.25 – 12.5 mg/cat q 12-24 h
Blood pressure measurement: Technique tips

Animal positioning
Minimal restraint
Minimal stress
Sitting
Lateral recumbency
May be performed in the exam room with the client or in a separate area.

While we try to perform blood pressure measurements under these ideal situations, there are exceptions to the rule. Some cats are "difficult to handle" but still need to have their blood pressure measured. An accurate blood pressure measurement can be obtained, even on a cat that is trying to "eat you alive".

Cuff placement
Cats—tail (median coccygeal artery), fore limb (median artery), rear limb (dorsal metatarsal artery)
Use the "up" leg

Cuff selection
Width of the cuff should be 40% of the circumference of the measurement site (tail, leg)
Cuff too small or too loose—falsely elevates the readings
Cuff too large or too tight—falsely lowers the readings
Obtain a series of 3-5 readings, with at least 30 seconds between readings to allow recirculation

Doppler Probe - use alcohol to separate the hair and apply gel to pick up signal.

To provide the best medical care for our feline patients:

Have a clearly defined health care program in place covering all life stages.

Educate employees and your clients about the recommended health care program.

Be consistent.

Identify and define disease at earliest possible stage.

Educate the client about the disease.

Develop clear follow up plan with the client.

Implement follow up plan. Use recall/reminder system.

Medical care program for Feline Chronic Renal Failure – Management Made Simple

Cats with chronic renal failure (CRF) have many issues that need to be addressed. Management of chronic renal failure can be simple if you recognize and correct these concerns early, delay the progression of existing issues, and improve or maintain residual renal function. By having a good medical plan in place, you can accomplish these goals. This case will highlight how the program works for one cat through its lifetime.
**Education:**


**Stage 1:**  
Creat < 1.6 mg/dl   Non-azotemic; some other renal abnormality without identifiable non-renal cause (ex: inadequate concentrating ability); abnormal renal palpation and/or imaging findings; proteinuria of renal origin; abnormal renal biopsy results. Renal function varies from 100% down to 33%.  
Old term: Early renal disease, renal insufficiency.

**Stage 2:**  
Creat 1.6 - 2.8 mg/dl   Mild renal azotemia. Clinical signs usually mild or absent. Renal function from 33% to 25%.  
Old term: Early renal failure.

**Stage 3:**  
Creat 2.9 - 5.0 mg/dl   Moderate renal azotemia. Many systemic clinical signs may be present. Renal function from 25% to 10%.  
Old term: Uremic renal failure.

**Stage 4:**  
Creat > 5.0 mg/dl   Severe renal azotemia. Many extra-renal clinical signs present. Renal function less than 10%.  
Old term: End stage renal failure.

Substaging using systolic blood pressure:
- Minimal risk  
  < 150 mmHg
- Low risk  
  150-159 mmHg
- Moderate risk  
  160-179 mmHg
- High risk  
  ≥ 180 mmHg

Substaging using urine protein/creatinine ratio:
- Nonproteinuric  
  < 0.2
- Borderline  
  0.2-0.4
- Proteinuric  
  > 0.4

**CRF Concerns & Follow-up Plans**

**Inadequate hydration:**
Maintaining a proper fluid balance in the CRF patient can be quite a challenge. Damaged kidneys waste fluid and electrolytes. It is essential that CRF cats always have access to clean, fresh drinking water. Increasing moisture content in the diet by feeding canned food and offering tuna juice and other broths may increase fluid consumption. Replacement of fluid and electrolytes may help stabilize a pet that appears to be drinking well. Early in renal disease, some cats may benefit from once weekly subcutaneous fluids to help maintain appetite and body weight. Subcutaneous fluid therapy should be tailored to the individual cat’s needs. Overhydration should also be avoided, as this can contribute to hypertension.

**Follow-up Plan:**  
Physical exam, Weight check
Potassium depletion:
Hypokalemia occurs commonly in CRF patients due to decreased dietary intake, increased urinary losses due to polyuria, increased fecal losses, and consumption of high-protein, low-potassium acidifying diets. Clinical signs of low potassium levels include generalized muscle weakness, cardiac arrhythmias. Ventroflexion of the neck is often seen with hypokalemia.
- Potassium gluconate: 2-6 mEq/cat/day
- Potassium citrate: 30 mg/lb/day divided every 8-12 hours. Has a beneficial alkalinizing effect

**Follow-up Plan: Physical exam, Bloodwork**

Metabolic acidosis (Blood bicarbonate or TCO₂ < 16 mmol/l):
Metabolic acidosis commonly develops in CRF patients. Adverse effects of chronic acidosis include anorexia, weakness, reduction of cardiac output, decreased hepatic and renal blood flow, induction of cardiac arrhythmias, increased protein catabolism, bone demineralization due to increased parathyroid hormone production, and increased potassium and taurine depletion.
- Goal: Total CO₂ level between 17 and 22 mEq/L
- Sodium bicarbonate: 1/8 tsp/cat daily to every other day
- Potassium citrate: 30 mg/lb/day divided every 8-12 hours. Has a beneficial alkalinizing effect

**Follow up Plan: Physical exam, Bloodwork**

Systemic hypertension:
High blood pressure is a common complication of chronic renal failure. The time to diagnose high blood pressure is before damage is done. Retinal hemorrhages and detachment can be avoided in a well-managed CRF patient. I recommend that Doppler ultrasonic blood pressure measurements begin in all patients at an early age as part of their yearly wellness exam. That helps the veterinarian establish a baseline for each individual pet. Once a pet has been diagnosed with CRF, blood pressure measurements should occur at least every 3 months or sooner if any concerns arise. High blood pressure can be a silent killer. Your clients are well educated about high blood pressure, so it is easy for them to understand the importance of blood pressure control in their cats.

**Follow up Plan: Physical exam including fundic exam, Blood pressure measurement every 3 months; Recheck BP measurement 1-2 weeks after starting drug therapy.**

Recurrent urinary tract infections:
No self-respecting bacteria will live in well-concentrated cat urine. However, our CRF patients are at high risk, as bacteria take advantage of the dilute urine seen in this disease. E. coli infections are the most common type of bacterial infections seen in CRF patients. As infections occur, the resistance pattern seems to get quite ugly. Treatment of urinary infections should be based on culture results. I typically culture the urine at the time of diagnosis, after 2 weeks on therapy, and then again one week after the pet finishes the course of antibiotics. The use of antibiotics that are concentrated by the kidneys (penicillins, cephalosporins, fluoroquinolones) can help address some of the more difficult-to-treat infections.

**Follow up Plan: Physical exam, Urinalysis +/- Culture every 3 months, Urinalysis when cat is ADR; May culture the urine when there is a major change in the patient even if there is no visible UTI.**
Anemia:
Anemia secondary to chronic renal failure is common as the disease progresses. It can also occur due to repeated blood draws and even due to phosphorus-restricted diets. As veterinarians, we must justify the need for blood work, never forgetting that our patients do not have an unlimited blood supply.

In anemic patients, erythropoietin 50-100 units/kg SQ 3 times weekly can be utilized to return the hematocrit to a normal level. Once the target hematocrit (30-40%) is reached, the dosing interval can be decreased to twice weekly. Most cats will require 2-3 injections weekly for maintenance. Iron supplements should be given to cats receiving erythropoietin injections because of the high demand on iron stores. A small percentage of feline patients will develop autoantibodies significant enough to cause profound anemia and transfusion dependency.

When should erythropoietin therapy be started? This varies from patient to patient. Persistent anemia (hematocrit < 20%) contributes to anorexia and weakness and probably warrants therapy. The frequency and amount of each blood draw should also be considered.

Follow up Plan: Physical exam, PCV every 3 months.

Hyperphosphatemia and renal secondary hyperparathyroidism:
There are many renal diets available that are phosphorus restricted for cats with hyperphosphatemia. It can be challenging, though, to convince our feline patients to eat these diets. Medical management of hyperphosphatemia can also be accomplished with the use of phosphate binders. These drugs only bind phosphorus in the diet and intestinal tract. These drugs do not work in anorexic patients.
- Aluminum hydroxide (Amphogel, Alternagel): 30-100 mg/kg/day divided with meals
- Calcium acetate (PhosLo): 20-30 mg/kg every 8-12 hours with meals
- Calcium carbonate (Tums): 30-50 mg/kg every 8 hours with meals

Renal secondary hyperparathyroidism is a concern in our feline patients with chronic renal failure. Calcitriol production is decreased as renal tubular function decreases. Calcitriol supplementation effectively controls secondary hyperparathyroidism. There is also some clinical evidence that suggests these cats experience improved appetite, brighter attitude, and a more active, longer life span.

Calcitriol should only be used in patients with a normal serum phosphorus level (less than or equal to 6.0 mg/dl). Phosphate binders can be used concurrently with this drug. If calcium-based phosphate binders are used, serum calcium levels should be closely monitored. Aluminum-based phosphate binders might be a better choice for these patients.

Calcitriol: 2.5-3.5 ng/kg orally every 24 hours; better to give at night on an empty stomach

Follow up Plan: Bloodwork every 3 months

Weight loss:
Maintaining body weight is a major goal of CRF management. Sometimes the challenge is not just how to get cats to eat the specially formulated renal diets, but to get them to eat at all!
To maintain appetite, the nausea and vomiting caused by uremic gastroenteritis should be controlled using H2 blockers, GI protectants and anti-emetics. Food aversion can develop when food is offered to a nauseous patient.
- Famotidine: 0.5 mg/kg PO or SQ every 12-24 hours
- Cimetidine: 5-10 mg/kg PO every 6-8 hours
- Sucralfate: 0.25-0.5 g/cat PO every 8-12 hours for gastric ulceration
- Metoclopramide: 0.2-0.4 mg/kg PO or SQ every 8-12 hours

Follow up Plan: Bloodwork every 3 months
The palatability of food can be enhanced by offering warm, moist food, using a food with a texture the cat is accustomed to, and adding broth or tuna juice to the food. Feeding patterns can also be modified by offering frequent meals, offering favorite foods and treats, and hand feeding the cat. Medications should not be mixed in food as this can contribute to food aversion.

Drugs can be used to stimulate appetite. Use of appetite stimulants does not replace the need to address the underlying reason for poor appetite (uremic gastroenteritis, anemia, metabolic acidosis, dental health).

Cyproheptadine: 2mg/cat every 12 hours

Feeding tubes can be placed in CRF patients to provide adequate nutrition as well as hydration. Nasoesophageal, esophageal and gastrostomy tubes can all be utilized. Feeding tubes are often placed in feline patients prior to renal transplantation. Some of these cats improve so much with the tube in place that the owners elect to delay or cancel plans for transplantation.

**Follow up Plan: Physical exam every 3 months; Weight checks monthly

Dental health:
Bacteria associated with dental tartar as well as dental pain due to diseased teeth and gums contribute to the overall decline of all geriatric patients. This is equally true in our CRF patients. Stable CRF patients should continue to receive regular dental cleanings and extractions to make sure good dental health is maintained. With good dental health, secondary infections are less likely as well as decreased food intake due to dental pain. Since dental procedures require general anesthesia, all CRF patients should receive IV fluids prior to, during and after their procedure. Blood pressure should be monitored during the procedure. Kidney-friendly anesthetics should be chosen for these patients, with a goal to minimize hypotension. Antibiotics should also be started prior to the dental procedure.

**Follow up Plan: Oral exam every 3 months; Dental prophy and extractions as indicated.

Pain management:
Pain is pain, no matter the age of the patient. Pain, whether acute or chronic, should be controlled as soon as possible. Special consideration should be given to any underlying conditions or drug interactions. Some causes of chronic pain include degenerative joint disease, inflammatory diseases, dental disease, and neoplasia. Acute pain can be caused by trauma, surgery, neoplasia, and diseases such as pancreatitis, urinary tract disease, and gastrointestinal disorders. In general, nonsteroidal anti-inflammatory drugs (NSAIDs) should be avoided in cats with renal compromise or preexisting gastrointestinal ulceration. There are a wide variety of oral and injectable pain medications available for use in the feline patient. Nutraceutical supplements may also help alleviate some forms of pain (glucosamine, chondroitin sulfate, omega-3 fatty acids).

**Follow up Plan: Physical exam every 3 months
Selected readings:


Websites:

www.aafponline.org
www.healthycatsforlife.com
www.iris-kidney.com
www.npwm.com
www.vet.cornell.edu/fhc/
www.veterinarypartner.com
www.vin.com
Focus on Feline Medicine: What to Do For Cats Who Cannot Breathe

Cats who cannot breathe are the most fragile patients we treat each day. It is important to balance diagnostic procedures with therapeutic intervention so that these cats can be quickly stabilized and effectively treated. This presentation will use case studies to highlight major points.

Emergency presentation:

(1) Quickly assess the cat’s status. Can the cat handle initial diagnostic tests (chest radiographs, bloodwork) if the cause is not readily apparent or are interventional measures (oxygen, drugs, thoracocentesis) required?

(2) Perform chest radiographs (NOT whole cat radiographs) if the cat is stable. Also consider an effusion check with ultrasonography if available.

(3) If the cat is not stable, administer emergency drugs (one injectable dose each of a corticosteroid, bronchodilator, and diuretic). Provide supplemental oxygen. Perform thoracocentesis. Drain both sides of the chest if fluid or air is present and submit fluid for analysis and cultures. If the tap is negative, put any material aspirated on a slide for cytologic analysis.

(4) Place the cat in an oxygen cage allowing the cat to stabilize if possible.

(5) Perform definitive diagnostics when the cat is more stable.

Physical exam findings once the cat has been stabilized:
- Be quick but thorough! Handle with care to prevent decompensation.
- Minimize handling. Hit the “high points” first. Perform as much of the exam from observation of the cat while it is in the oxygen cage.

Body condition
Hydration status
Mucous membrane color
Heart rate and rhythm, presence of murmur
Pulse rate and character
Respiratory rate and character; chest compressibility
Type of breathing pattern: obstructive (slow and deep), restrictive (rapid and shallow)
Open mouth breathing, panting, increased abdominal effort
Nasal congestion, nasal discharge
Oral exam
Ocular exam
Otic exam

Palpation of cervical trachea
Abdominal palpation
Musculoskeletal exam
Neurologic evaluation
Historical findings can provide important clues and insights into the cat’s clinical condition.
- geography and environment
- recent exposure to other animals, toxins, irritants, trauma
- past illness and injuries
- vaccination and heartworm status
- description of clinical signs
- duration of clinical signs
- progression of clinical signs
- any previous treatment/response to therapy

Rule outs should be based on disease localization.

- Airway diseases
  Upper airway: stenotic nares, nasal passage obstruction, nasopharyngeal polyp, laryngeal dysfunction, neoplasia, foreign body, trauma, parasites, inflammation

  Lower airway: extraluminal compression (lymphadenopathy, cardiac enlargement, heart-based tumors), allergic, inflammatory, infectious, parasitic, neoplasia, airway irritant

- Pulmonary parenchymal diseases: pneumonia (bacterial, viral, fungal, parasitic, aspiration), edema (cardiogenic, noncardiogenic), neoplasia (primary, metastatic), inflammatory, acute respiratory distress syndrome, hemorrhage (trauma, coagulopathy), pulmonary thromboembolism

- Pleural diseases: pneumothorax, hemothorax, pyothorax, chylothorax, cardiogenic effusions, neoplasia, peritoneopericardial hernia, FIP

- Cardiac disease

- Diaphragmatic diseases: hernia; impingement due to organomegaly, obesity, peritoneal effusions, masses/neoplasia

- Anemia, Methemoglobinemia

- Toxin exposure

- Neurologic compromise: tick paralysis, botulism, central nervous system disease

Emergency drugs:

- Oxygen, oxygen, and more oxygen.
- Corticosteroids: Dexamethasone SP 1-2 mg/kg SQ, IV, IM
- Diuretics: Furosemide 2-4mg/kg SQ, IV, IM
- Bronchodilators: Aminophylline 4 mg/kg IM
  Terbutaline 0.01 mg/kg SQ
Follow-up Care:

-Schedule recheck exams based on: Severity of disease, control of clinical signs/response to therapy, patient's fragility

Selected readings:


Focus on Feline Medicine: Yellow Cats

Presenting complaint î “My cat is a little off.”

Perform a complete physical exam î “Your cat is a little yellow.”

Obtain minimum database:  
- Blood pressure measurement  
- PCV, blood smear evaluation  
- CBC and biochemistry profile  
- Urinalysis  
- Feline viral tests î FeLV, FIV

Characterize the icterus:  
- Prehepatic or Hemolytic î low PCV, Heinz bodies, visible blood parasites  
- Hepatic î Poikilocytes (irregularly irregular RBCs)  
- Posthepatic

Consider disease rule-outs:  
- Prehepatic or Hemolytic  
  - Infectious î Mycoplasma/Hemobartonella, Cytauxzoonosis  
  - Immune-mediated  
  - Hypophosphatemia  
  - Blood transfusion reaction  
  - Reaction to drugs î propylene glycol, benzocaine, cetocaine, acetaminophen, methylene blue

- Hepatic  
  - Hepatic lipidosis  
  - Cholangiohepatitis  
  - Infectious î viral (FIP, Calici), bacterial, fungal, parasitic  
  - Neoplasia î lymphoma, mast cell tumor, others  
  - Toxins/ drugs î diazepam, methimazole  
  - Polycystic disease  
  - Hepatic necrosis

- Posthepatic  
  - Gallbladder/ Biliary tract disease î cholecystitis (infection, inflammation), obstruction or rupture due to gallstones, inspissated bile, neoplasia, or trauma  
  - Pancreatic disease î pancreatitis or pancreatic tumor obstructing the bile duct  
  - GI disease î IBD, foreign body or tumor blocking duodenal papilla
Start in-depth diagnostic testing:

**Imaging:**
- Abdominal radiographs
- +/- Chest radiographs
- Abdominal ultrasound

**Coagulation tests:**
- Prothrombin time (PT)
- Activated partial thromboplastin time (PTT)
- Activated clotting time (ACT)
- Platelet count

**Tissue sampling:**

- Fine needle aspiration: 22 gauge, 1.5 inch spinal needle with 12 cc syringe
- Liver cytology: Useful in identifying lipidosis, neoplasia, suppuration and infection.
- Liver biopsy: Ultrasound-guided (Tru-cut needle - 14, 16, or 18 gauge), laproscopic or surgical (wedge)
- Liver histopathology: Required for definitive diagnosis.
- Liver culture: Helps identify bacterial infections and may occasionally isolate fungal infections. Can be performed from needle aspiration and biopsy samples.

**Other blood tests to consider:**
- Total thyroxine concentration
- Feline TLI/PLI test
- Infectious disease titers (*Toxoplasma gondii*, Coronavirus tests)

**Initiate therapy based on findings:**

What immediate supportive care should be provided to animals with suspected liver disease?

Fluid, electrolyte, acid-base, coagulation, and glucose abnormalities should be corrected. Depending on acid-base and electrolyte status, 0.9% NaCl and Normosol R are appropriate fluid choices. Fluids with lactate added as a buffer should be avoided in patients with liver dysfunction or hepatic encephalopathy as the liver is required to metabolize lactate to produce bicarbonate. Dextrose supplementation is also not recommended as this may promote further hepatic triglyceride accumulation. Potassium supplementation is required for most cases. Bacterial translocation from the intestines into the liver is common in many liver diseases, so antibiotic administration should be considered. Penicillin derivatives or first-generation cephalosporins administered parenterally are adequate if clinical findings or sepsis are not present. Enrofloxacin should be considered in animals with suspected gram-negative sepsis. Vitamin K₁ should be given subcutaneously to animals with elevated activated clotting times or PT/PTT. Supplementation with B vitamins is suggested for most cases. Anti-emetic medications, such as metoclopramide, are often indicated. Hepatic encephalopathy, if present, is managed with low protein diets to decrease production of intestinal ammonia and lactulose to decrease
ammonia absorption and increase intestinal motility time. Oral antibiotics (neomycin, metronidazole, amoxicillin) may also be utilized to decrease the number of enteric bacteria, reducing the synthesis of ammonia. Appetite stimulants, including cyproheptadine and benzodiazepams, generally are not successful alone. Benzodiazepams may lead to severe sedation if hepatic dysfunction is severe. Ursodeoxycholic acid may also be beneficial in cats with cholestatic liver disease. This drug promotes the flow of bile and modulates the immune response in the liver.

Early, aggressive nutritional therapy is the key to prevention of or successful treatment of hepatic lipidosis. Food is the drug that treats this disease. Initial short-term support may be provided by a nasoesophageal tube. However, because nutritional support is required for at least 3-6 weeks in most cases, a gastrostomy or esophagostomy tube is strongly recommended once the pet is stable enough for anesthesia.

What diet and how long should a cat be fed once a feeding tube has been placed?

A liquid diet may be utilized for the first 24-48 hours after tube placement, allowing time to transition to a food that can be syringe-fed through the tube. Commercially prepared feline foods should be used to avoid nutritionally incomplete diets. Multiple small meals should be fed to cats to provide 60-80 kcal/kg/day. Most full-grown cats can handle 50-80 mls of food per feeding when the volume of food at each meal is gradually increased over several days. This gradual increase will help increase the stomach capacity which is initially small in anorexic patients. Protein should not be restricted unless signs of hepatic encephalopathy are present. Food should always be offered by mouth, but tube feeding should continue as scheduled even as the pet starts nibbling at food. Once the patient is beginning to eat regularly, the amount of food may be slowly decreased. The tube can be pulled once the pet is eating well and has recovered completely. Most cats require tube feeding for at least 4-6 weeks. The tube should not be pulled until it has been in at least 2 weeks to allow appropriate healing.

Proper intake of the food can be difficult if the pet is experiencing nausea or vomiting with tube feeding. Warming the food, feeding smaller amounts of food more frequently, increasing the amount of fluid given through the tube to maintain proper hydration, and administering an anti-emetic/prokinetic medication such as metoclopramide can help alleviate these problems. Protracted vomiting may be a sign of other underlying disorders (pancreatitis), worsening of the hepatic disease or tube problems (cellulitis, secondary infection) and should be investigated. Intravenous or subcutaneous fluids may be needed if hydration cannot be maintained with tube feeding.

What nutritional supplements may be useful in the treatment of feline liver disease?

A variety of vitamins and dietary supplements may be helpful, though controlled studies are needed. Current recommendations include oral L-carnitine, B-complex vitamins, Vitamin E, Vitamin C, taurine, and zinc. Studies do show that supplementation with S-adenosylmethionine (SAMe) and milk thistle (silymarin) may be beneficial.

What instructions should the owner be given for at-home care of the feeding tube?
The owner should inspect the tube site daily for signs of infection, irritation or swelling. The area around the tube may need to be cleaned with a warm, wet cloth each day as healing and a good seal occur. The tube is typically marked with a permanent marker and the owner should watch for any signs of movement of this mark, which might suggest tube placement issues. To avoid tube clogging, the owner should flush the tube well with warm water after each feeding or medication administration. To unclog a tube, 5 mls of carbonated beverage (ex: Coca-Cola) should be flushed into the tube and allowed to sit for 5-10 minutes. The tube can then be flushed with warm water and feeding resumes.

What is the prognosis for recovery from diseases that cause ‘yellow cats’?

The prognosis is overall good, depending on which disease is present and how early the disease is recognized and treated. The liver has the ability to regenerate, but treatment may be long. Some conditions require life-long therapy. Yellow cats with hepatic lipidosis can recover with aggressive nutritional and medical therapy. Owners must be counseled that recovery may require up to 20 weeks before spontaneous eating occurs. With treatment, cats have a greater than 60% chance of recovery. Recurrence is rare. Without treatment, hepatic lipidosis is usually fatal, leading to progressive liver failure.

Suggested drug and supplement doses:

Cephalosporin: 22 mg/kg IV or orally/by tube every 8 hours
Enrofloxacin: 2.5 mg/kg IV slowly or orally/ by tube every 12-24 hours
Metoclopramide: 0.2-0.4 mg/kg SQ or orally/by tube every 8 hours
Cisapride: 5 mg orally/by tube every 8 hours
Neomycin: 20 mg/kg orally/by tube three to four times daily
Metronidazole: 7.5-15 mg/kg orally/by tube every 12 hours
Amoxicillin: 22 mg/kg orally/by tube every 8-12 hours
Lactulose: 0.25-1 ml orally/by tube to effect
Cyproheptadine: 2mg orally/by tube every 12 hours
Ursodeoxycholic acid: 10-15 mg/kg orally/by tube daily
Prednisolone: 0.5-2 mg/kg every 12-24 hours orally/ by tube (wide range)
Chlorambucil: 1.5-4 mg/m² twice weekly to EOD orally
Oral L-carnitine: 250-500mg/cat orally/by tube daily, all at once or divided, in food
Vitamin K₁: 0.5-1.5 mg/kg SQ every 12 hours for 2-3 doses
B-complex vitamins: 2 ml/liter in IV fluids (avoid light exposure)
Vitamin B₁₂: 0.5-1 mg IM or SQ weekly or twice weekly
Thiamine: 50-100 mg/cat orally/by tube daily
Oral vitamin E: 10-100 IU/kg daily in food (use water soluble form)
Oral vitamin C: 30 mg/kg daily in food
Oral taurine: 250-500 mg/cat daily, all at once or divided, in food during the first 7-10 days
Zinc: 7-10 mg/cat orally/by tube daily
SAMe: 30-60 mg/kg orally/by tube once to twice daily on an empty stomach.
Milk thistle (silymarin): 50-200mg/kg orally/by tube daily
Tube feeding schedule:

1. Calculate basal energy requirement (BER).
   
   \[(30 \times \text{Weight in kg}) + 70 = \text{BER}\]

2. Calculate maintenance energy requirement (MER).
   
   \[1.25 \times \text{BER} = \text{MER}\]

3. Calculate volume of food needed.
   
   \[\text{MER} \times \text{kcal/ml of chosen food} = \text{mls food/day}\]

Feed small amounts frequently (ex: 5 mls every 2-4 hours), slowly increasing the amount over the first few days to reach the calculated goal (mls food/day). The number of feedings per day can decrease as the amount per feeding increases. Food can also be left out for the pet to eat free-choice. Any food eaten does not replace the tube feedings.

Follow-up care:

Schedule rechecks based on:

- Severity of disease, control of clinical signs/response to therapy, patient’s fragility

Case studies will be utilized in this presentation.

**Selected readings**


Focus on Feline Medicine: The Medicine Cabinet

Cats handle drugs in a different fashion than dogs. While this is not a surprise, there are some drugs that every practitioner should be aware of that work really well for their feline patients. The focus of this discussion will be to highlight these drugs and their uses, showing why they deserve to be in the feline medicine cabinet. Case studies will be utilized.

**Prednisolone**
Prednisone is converted to prednisolone in the liver. Prednisolone is the active form of the drug. While the cat can make this conversion from prednisone to prednisolone, the conversion varies from cat to cat. Some cats do not convert enough prednisone to prednisolone to effectively treat the disease, appearing to be treatment failures. Using prednisolone skips this extra step and often the cats respond more reliably to prednisolone. Lower doses of prednisolone may also be effective for long-term control of disease (asthma, inflammatory bowel disease, etc.). Cats handle corticosteroids much better than our canine patients, with fewer reported side effects.

- **Dose:** Varies widely depending on the disease being treated
  - Neoplasia (lymphoma): 10 mg per cat daily, often used in conjunction with other drugs
  - Immune-mediated diseases: 1-2 mg/kg q 12 hours to start, decreasing to lowest effective dose
  - Inflammatory disease: 1–2 mg/kg once daily, decreasing to lowest effective dose

**Budesonide**
Budesonide is a potent glucocorticoid (15 times more potent than prednisolone). Its topical anti-inflammatory effects are particularly useful in controlling inflammatory bowel disease in cats. The drug is absorbed systemically, but steroid side-effects are minimized by the high first-pass metabolism effect through the liver. The drug usually needs to be compounded for our feline patients.

- **Dose:** 1 mg PO once daily

**Piroxicam**
This drug is a strong non-steroidal anti-inflammatory drug (NSAID) that can be used to control pain and swelling in a wide variety of diseases. It should never be combined with corticosteroids or other NSAIDs due to the risk of gastrointestinal ulceration. I will use this drug in cats to treat inflammation in the nose, lungs, and bladder. This drug also controls pain due to osteoarthritis and neoplasia in cats. It has also been used as adjunctive treatment of some cancers (transitional cell carcinoma, adenocarcinomas). This drug is not recommended for use in cats with kidney disease. Concurrent use of GI protectants is generally not needed.

- **Dose:** 0.3 mg/kg PO q 24-48 hours with food

**Tramadol**
Tramadol is drug used for its analgesic effects. It is a centrally acting opiate agonist that is not a controlled substance. It can be used alone or in conjunction with other drugs (corticosteroids, NSAIDs). This drug can have some sedating effects, which can be minimized with lower doses. The drug is safe to use in cats with renal disease.

- **Dose:** 1/8 to 1/4 of a 50 mg tablet (6.25–12.5) PO q 12-24 hours; 4 mg/kg PO q 12-24 hours
**Doxycycline**
This antibiotic is useful for treating a wide variety of bacterial and other unusual infections in cats. I particularly like to use this drug in cats with nasal disease (to treat secondary infections), possible *Mycoplasma* infections, anemias of unknown etiology (erythrocytic mycoplasmal infections, *Ehrlichia* spp.), *Chlamydia psittaci*, polyarthritis, Mycobacteria, L-form bacterial infections. This drug also seems to have some anti-inflammatory effects. It is important to make sure the drug is given with food or water, as significant ulceration and stricture of the esophagus have been reported.

Dose: 5 mg/kg PO q 12-24 hours with food

**Calcitriol**
Renal secondary hyperparathyroidism is a concern in our feline patients with chronic renal failure. Calcitriol production is decreased as renal tubular function decreases. Calcitriol supplementation effectively controls secondary hyperparathyroidism. There is also some clinical evidence that suggests these cats experience improved appetite, brighter attitude, and a more active, longer life span.

This drug should only be used in patients with a normal serum phosphorus level. Phosphate binders can be used concurrently with this drug. If calcium-based phosphate binders are used, serum calcium levels should be closely monitored. Aluminum-based phosphate binders might be a better choice for these patients.

Dose: 2.5-3.5 nanograms/kg orally every 24 hours; better to give at night on an empty stomach

**Ursodiol (Actigall)**
Ursodeoxycholic acid is a therapeutic bile acid used for stimulation of bile flow in cholestatic disease and immune modulation in inflammatory liver diseases. It is believed to have hepatoprotective effects. This drug is useful in cats with hepatic lipidosis or inflammatory liver diseases.

Dose: 10-15 mg/kg q 24 hours with food.

**Benazepril (Lotensin)**
Benazepril is an ACE-inhibitor that is recommended for use in patients with high blood pressure and proteinuria. Many of our renal failure patients would benefit from this drug. While some clinicians prescribe this drug in all their feline renal failure patients, I prefer to document blood pressure concerns and/or proteinuria first.

Dose: 0.25 ÷ 0.5 mg/kg q 12 - 24 hours.

**Amlodipine (Norvasc)**
Amlodipine is a calcium-channel blocker that is used to treat high blood pressure in cats. Since most of the drug’s vasodilating actions are peripheral, it has minimal cardiac effects and is not used as a first line of therapy in cardiac disease.

Dose: 0.625 ÷ 1.25 mg once daily, though cats with severe hypertension or large body size may require twice daily dosing.

**Insulin Glargine (Lantus)**
This is the “insulin du Jour,” but it is very effective at controlling diabetes mellitus in cats. Insulin Glargine is a long-lasting human insulin analog produced by recombinant DNA technology using a non-pathogenic strain of *E coli*. This insulin requires U-100 syringes. The bottle of insulin may remain potent for 2-6 months once opened.

Dose: 0.25 ÷ 0.5 U/kg q 12 - 24 hours. Adjust dose as needed. Dose may decrease after 2 weeks of starting therapy in new diabetic patients.
Fluticasone inhaler (Flovent)
Fluticasone is a glucocorticoid that has potent anti-inflammatory effects. It is commonly used as an aerosol for the treatment of feline asthma patients. Though some drug is absorbed systemically, steroid side-effects are minimal.

Dose: Fluticasone 220mcg (1 puff) q 12 – 24 hours. Treatment can be combined with albuterol inhaler as needed for symptomatic relief and oral corticosteroids for more severe cases.

Cyproheptadine
This antihistamine has a unique side effect in our feline patients. It can act as an appetite stimulant. I will often use this drug to "jump start" a pet's appetite as I definitively treat the pet's underlying disease which is contributing to the anorexia. The drug is also useful as an adjunct treatment in feline asthma, as it also possesses serotonin antagonistic properties, decreases smooth muscle contraction and may cause bronchodilation. A possible side effect of this drug is estrus-like behavior, which resolves with discontinuation of the drug.

Dose: 1-2 mg PO q 12 hours

Meclizine
This is an excellent drug to use in cats with vestibular disease. This drug is an antihistamine that has antiemetic properties as well as anti-motion-sickness properties that are not completely understood. Side effects are few, though sedation can occur in some cats.

Dose: 12.5 mg per cat once daily

Propofol
Propofol is a short acting hypnotic agent that is used to induce general anesthesia in patients. A unique side effect of the drug is appetite stimulation. I tend to use this drug for short procedures (bone marrow aspirates, ultrasound guided biopsies). It is important to remember that this drug has little to no analgesic properties, so other drugs may be needed to provide control of pain. Rapid boluses may also induce apnea. A recent study showed that repeated administration of this drug does not cause clinically relevant hematologic changes and is not associated with any adverse effects.

Dose: 4-6 mg/kg IV to effect Constant rate infusion: 0.1-0.6 mg/kg/min with IV fluids

Intranasal vaccines
Rhinitis is a frustrating disease. Stimulation of the local mucosal immunity with intranasal vaccines can decrease the severity and frequency of nasal congestion due to rhinitis. I have had several patients that have not experienced another relapse as long as they received an intranasal vaccination every 6 months. The initial vaccine is given and followed with a booster in 2-4 weeks. Further intranasal vaccines are given every 6 months, based on severity and control of clinical signs.

Transdermal medications
Great idea, but problematic. Are we really sure the medicine is being absorbed? Compounding pharmacies are more than willing to make up drugs (almost any drug) in a transdermal preparation. Many of these preparations have no data that supports their efficacy. And who is responsible for treatment failure? Not the compounding pharmacy. The prescribing doctor must take the blame. Do not prescribe any medications as transdermal administration unless there is research that supports the efficacy of the transdermal drug preparation.

What about drug exposure to others in the family? Any person or animal that touches the drug is at risk of absorption and exposure to the drug. This concern is amplified for households with small children.

Bottom line: The prescribing veterinarian must assess the benefits and risks of transdermal drug delivery.
Selected Readings


