Many thanks to my pain management mentor, Peter Hellyer, DVM, MS, DACVA, founding President of the International Veterinary Academy of Pain Management.

For pain in animals, pain is what WE (humans) say it is. There is tremendous individual variability among both patients and observers. There is not one “right” answer. Pain is complex and scientifically intriguing, clinically challenging, and easy to overlook (especially in cats). To improve the treatment of feline pain, we MUST make changes - - never an easy task.

The fundamentals of acute pain management mean understanding that treating pain is good medicine, that providing peri-operative analgesia means before, during, and after the surgery, and that multi-modal analgesia is the strategy of choice.

We need to update our previous training about different “types” of pain - - acute vs. chronic, cancer pain, acute on chronic, etc. We now understand that pain is a spectrum that transitions and transforms from “adaptive” pain to “maladaptive” pain. If we deal with pain aggressively early on, we prevent the transformation to maladaptive pain. Maladaptive pain gives us more targets to treat. Wind-up involves the sensitization of nociceptors, and peripheral and central pain pathways, in response to a barrage of afferent nociceptive impulses resulting in expanded receptive fields and an increased rate of discharge. While general anaesthesia causes unconsciousness, thus preventing the cortical experience of pain, it does not prevent wind-up. Without proper intervention (e.g. pre-emptive analgesia), the pain experience upon recovery from anaesthesia will be worse upon awakening.

Local anesthetics prevent windup by blocking pain signals. Opioids obtund windup. N-methyl-D-aspartic acid (NMDA) receptor antagonists block central sensitization (e.g. ketamine CRI). Part of the therapeutic approach means to minimize tissue damage when possible. The pharmacological approach means blending medications:

- Opioids
- (+/-)Alpha-2 agonists
- Local anaesthetics
- NSAIDs
- Ketamine (CRI)
- Sedation (acepromazine is NOT analgesic)

Other strategies include good nursing care, interaction with care-givers, ice packs, supportive bandages, lubricating eyes, emptying the bladder, removing dried blood and soap, providing plastic sheets with absorbent liners, supporting head and limbs, turning regularly. Complementary techniques may also help (acupuncture, therapeutic laser, etc.). Keep your patient warm before during and after the procedure, provide an IV fluid bolus before surgery, provide IV fluids during every anaesthetic event, and pre-oxygenation before beginning.

Multimodal therapy utilizes multiple actions on the CNS to prevent and treat pain. Sedatives and opioid analgesics are the most common combination of drugs used prior to general anaesthesia.

Acepromazine as a pre-med
- Excellent tranquilizer
- NO analgesic effects
- Potentiates opioid effects (synergistic) in the pre-med
- Use very low doses
- Cats – 0.01 mg/kg SQ
- Dilute to 1 mg/ml solution

Benzodiazepines (e.g. diazepam, midazolam)
- Few cardiopulmonary effects
- Not a good anxiolytic when used alone
- Can cause paradoxical excitement (diazepam)
- We use midazolam for INDUCTION, and NOT as part of the pre-op protocol
- Induction dose – 0.25 mg/kg IV (BOTH dogs & cats)

a2-agonists (e.g. dexmedetomidine):
- Dose-dependent sedation, cardiopulmonary depression, and analgesia
- Pick your patients carefully!!!
Opioids
- **μ-agonists**: morphine, hydromorphone, fentanyl
- Cornerstone of perioperative pain management
- Given to effect
- Possible bradycardia, respiratory depression, nausea, but ONLY when the need for pain relief is exceeded by the dose
- Good for moderate to severe pain
- Morphine is not as effective an analgesic for cats as dogs, so it will not be discussed here.

**Hydromorphone**
- Moderate to severe pain
- Similar in action and duration to morphine w/ no histamine release
- Less vomiting than morphine in non-painful patients
- Duration 4 hr IV, IM, SQ
- Possibly better efficacy in cats than morphine, but hyperthermia at analgesic doses in many cats
- Pre-op with low-dose (1mg/ml) acepromazine:
  - 0.05 mg/kg SQ
- Post-op:
  - 0.05 mg/kg SQ or IV

**Fentanyl**
- Moderate to severe pain (similar to morphine)
- Rapid onset (minutes), VERY short duration (minutes)
- IV, IM, SQ, epidurally (transdermal – no good)
- Best as IV CRI for balanced anesthesia or for unremitting pain
- Loading dose, then infusion
- Pre-op bolus:
  - 5 µg/kg
- Intra-op CRI:
  - 20 µg/kg/hr
- Post-op CRI:
  - 2 – 10 µg/kg/hr

**Buprenorphine**
- Partial μ-agonist, mild to moderate pain, drowsiness (little sedation), duration 6 to 12hr
- Post-op:
  - 0.03-0.05 mg/kg
- NOT absorbed via SQ
- Use IV or TM (can use IM if needed)
- NOW we have Simbadol® from Zoetic (1.8mg/ml)
  - VERY DIFFERENT dosing than conventional, human formulation, buprenorphine
  - This formulation MUST NOT be sent home with clients!!!

**Butorphanol**
- Mixed μ-agonist/antagonist with a ceiling effect and an EXTREMELY short duration (@20 min analgesia)
- Attenuates the efficacy of subsequently administered μ-agonists (long blockage of μ-receptors) to PREVENT effective analgesia
- **NOT AN EFFECTIVE ANALGESIC!**
- ONLY good for smoothing out dexmedetomidine

**Ketamine**
- NMDA receptor antagonist
- No longer has a place for anaesthesia induction
  - Dissociative (induction) dose merely creates dissociation, no long-lasting pain relief
  - Rough to sleep, rough to consciousness
- Best in CRI application for balanced anaesthesia (prevents wind-up)
- Can also use as CRI to “ramp-down”/”break cycle” of chronic pain
- Pre-op bolus:
  - 0.5 mg/kg
- Intra-op CRI:
  - 10 µg/kg/minute
- Post-op CRI:
Creating the acute pain plan/general anaesthesia

- Pre-med (Hydro+ace, no anticholinergic) + EMLA
- Pre-oxygenation during induction
- Induction (propofol + midazolam) followed by loco-regional blocks
- Inhalant maintenance
- +/- adjuncts (CRI)

Post-op pain management

Opioid

- Hydromorphone (careful about feline hyperthermia)
- Buprenorphine
  - IV or TM
  - Mild – moderate pain
  - Don’t forget Simbadol®
- NSAID (if appropriate for the patient)
- +/- Adjuncts - CRI, cryotherapy, therapeutic laser
- Other consideration:
  - Gabapentin

Gabapentin

- Neuromodulator at the $\alpha$-2-δ ligand of Ca channel in dorsal horn of spinal cord
- Alters calcium permeability & raises firing threshold
- Like resetting a pain thermostat
- Standard for chronic maladaptive pain – new in perioperative setting – in C-section & knee arthroplasty, decreased need for opioid (human studies)
- No good studies yet in dogs or cats – anecdotally, great results
- Some good response within 24 – 48 hrs, max effects within
- 5 – 7 days
- 5 – 15mg/kg PO BID for 10 – 14 days, q 24hr for 7 – 10 days, then discontinue

Pain summary

- LOOK for pain and you will find it
- Remember the risk factors (age, breed, size, history of injury, etc.)
- Learn how to “ask” your patients if they hurt
- Learn how to respond when they say “yes”

Resources
Veterinary Anaesthesia Support Group
www.vasg.org
American Academy of Pain Management
www.aapainmanage.org
American Society of Pain Educators
www.paineducators.org
Building a Chronic Pain Management Pyramids for Cats

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The Downing Center for Animal Pain Management
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When building the chronic pain management pyramid, begin at the beginning with a thorough examination, including a neurologic exam, soft tissue palpation, joint ROMs, and gait assessment. Perform a metabolic profile so as not to miss important co-morbidities. And don’t forget radiographs when they are indicated so as not to miss an obvious OSA and treating it as an OA. Be sure to treat the treatable - - and treat all the treatable. Make a plan and work the plan because chronic pain is best addressed from a MULTIMODAL approach. It is no longer appropriate simply to throw an NSAID at the patient.

We need to break the pain cycle as quickly and effectively as possible before initiating physiotherapy and/or tissue manipulation. Multimodal management of chronic pain means multi-tasking - - think “plate spinning” or juggling. The client is an absolutely essential partner in the process, or the process is doomed to fail. There is no one right answer, but we need to set priorities (and there may be multiples) based on the needs of each individual patient.

Perform your pain palpation systematically and the same way each time. Use 4kg of pressure at each palpation site, and use the fleshy part of P3 (NOT the fingertip). Begin in the paraspinals at the base of the occiput and proceed to the base of the sacrum. Palpate the paraspinals at approximately each spinal segment. Palpate the circumference of the body at the base of the neck by the hands of the clock - - 10 & 2, 9 & 3, 8 & 4. Palpate caudal to the scapulae at those same “clock” points. Palpate at the T/L junction and proceeding to the L/S. Squeeze the proximal quadriceps between the flat of the thumb and the lateral index finger. Perform joint ROMs from toes to torso. Once through the whole body, return to the areas exhibiting a reaction and evaluate with additional palpation and/or ROM to better identify and characterize the presence and nature of pain. Teach/drill/practice and include the entire

Most chronic pain patients are less active, and consequently are overweight. Dr. Denis Marcellin-Little does a great presentation articulating that the most important physiotherapy treatment for chronic pain patients is normalizing body condition. Make a long-term nutritional plan right at the beginning. If a co-morbidity exists, plan for appropriate therapeutic nutrition once weight loss is achieved. Therapeutic nutrition is best achieved with a fixed formulation and consistency of feeding.

Break the pain cycle pharmacologically. NSAIDs remain one cornerstone of chronic pain management, particularly in the initial stages. They decrease inflammation and provide analgesia by acting at various locations within the nervous system. Once pain is controlled, we can (and should) titrate the dose to lowest effective dose, and that may be 0. Once removed, the NSAID can then be reserved for use as an inflammatory pain flare. Do not “mix & match” NSAIDs.

Chronic pain is “maladaptive” pain (see Clifford Woolf) or “maldynic” pain (see James Giordano). Maladaptive pain demands we target the dorsal horn of the spinal cord. “Targeted therapy” is a relatively new concept in human pain management, and a REALLY new concept in veterinary medicine.

Gabapentin affects α-2-δ subunit of the calcium channel in the dorsal horn of the spinal cord. It is an important gold standard for chronic, maladaptive pain management in humans, and it is emerging with a perioperative role. We need to dose appropriately at 5 – 15 mg/kg BID – TID to start. You will see drug activity within just a few days and maximal effects within 7 – 10 days. DO NOT reduce the dose too quickly or you will risk rebound pain. Begin your dose reduction following at least several months of stability. Long-term dosing is fine - - there are no liver or kidney issues to worry about. Sedation is the dose-limiting side effect. If sedation occurs, do not discontinue gabapentin - - simply reduce the dose and proceed with your plan. This drug has non-linear pharmacokinetics which makes the dose escalation very different from any other drugs we generally reach for. Evaluate the patient, calculate the dose, and begin with the BID dose given ONCE daily in PM for 3 days, then give the dose BID (e.g. 50mg PO once in PM for 3 days, then 50mg PO BID). Reassess the cat in 10 – 14 days. If it is still painful, increase the dose (e.g. 50mg PO TID). Reassess again in 10 – 14 days. If the cat is still painful, increase the dose again (e.g. 100mg PO BID). Once the cat is comfortable stick to that dose for a minimum of 4 – 6 months before beginning de-escalation of the dose, and DO NOT be in a hurry to de-escalate. I actually NAEVER do… The first dose de-escalation should come a MINIMUM of 4 - 6 months after stabilizing the cat’s pain at the lowest level. Decrease the dose, then recheck in 2 – 3 weeks to look for breakthrough pain. The next de-escalation should come in 2 – 4 months, recheck in 2 – 3 weeks for breakthrough pain, etc. Repeat the cycle on this interval. If the pain returns, simply increase the dose - - e.g. 100mg PO BID, then decrease the dose to 50mg PO TID, then decrease to 50mg PO BID, etc. Just a reminder, I NEVER decrease or eliminate gabapentin in my chronic feline pain patients.

Amantadine is an NMDA receptor antagonist that complements NSAIDs and gabapentin. We only have data for dogs, but I use this drug as an adjunct in cats routinely. We use 2 – 5 mg/kg/day. It is exceptionally well tolerated long-term compounding works great.

Tramadol is useless and should not be used… period.
Adequan® is VERY useful in cats with OA. This reflects extra-label usage. Give the injections SQ and NOT IM. Teach clients to dose this at home. Use the canine dosing for cats - - 2 mg/# SQ twice weekly for 4 weeks, then once weekly for 4 weeks, then twice monthly for long-term maintenance. Start using as soon as OA is diagnosed. Long-term use works very well.

As for nutrition and nutraceuticals, follow the evidence - - HPD j/d® Feline, glucosamine/LMW chondroitin/ASU, Omega 3 FA’s, Microlactin®,

Microlactin® (Duralactin® by VPL) is a milk protein concentrate from the milk of hyper-immunized cows. Hyper-immune milk factor (HIMF) inhibits inflammation in many animal models. It appears to be effective regardless of the etiology of inflammation and demonstrates no evidence of GI irritation. It works by a different mechanism than NSAIDs or corticosteroids. The first data about the anti-inflammatory activity in milk was disclosed in 1981. The novel activities illuminated from pharmacological studies on THIS molecule include the following:

- Activate macrophages
- Inhibit neutrophil migration
- Inhibit neutrophil adhesion
- Inhibit infection-induced inflammation
- Inhibit arthritis
- Suppress edema (rat model)
- Inhibit auto-immune disease

Microlactin® exhibits a very selective mechanism by blocking cytokines which contribute to the perpetuation of inflammation. It modifies the biological response to inflammation and changes the response of cytokines and neutrophils. It alters the signaling to neutrophils that “calls” them to the sites of inflammation. The neutrophils then do not release the destructive enzymes that perpetuate the inflammatory process. We see much same efficacy profile as NSAID, but the action happens by a different mechanism, so there is no NSAID adverse event profile. Microlactin® can be used safely in dogs, cats, and horses. The dose in cats (per Dr. James Gaynor) is 30 - 50 mg/kg PO BID. It takes time for maximal effects. We see initial effects within 4 – 7 days and maximal effects in 10 – 14 days. This is why Microlactin® is not well positioned for acute pain. For chronic pain, during weeks 1 – 3, overlap with the NSAID, steroid, etc. After week 3, continue Microlactin® for long-term anti-inflammatory activity.

Physiotherapy/physical medicine modalities:

- Heat
- Cold
- Therapeutic Laser
- NMES
- TENS
- Therapeutic U/S
- Tissue mobilization
- Medical massage

Tui Na (Chinese medical massage)

- Acupuncture
- Chiropractic/osteopathic manipulation
- Myofascial trigger point therapy
- Hydrotherapy
- E-stim whirlpool
- Swimming
- UWT

Be as specific as possible when making your pain management plan. Write everything down and have clients keep an “activities of daily living” (ADLs) diary. Conduct a medication, feeding, nutraceutical review at each visit. Once the patient is comfortable/stable, functional, and strong, you can consider removing some elements of the pain management pyramid.

Change only one thing at a time. Consider at least 1 – 3 months of stability before adjusting medication doses. Begin by reducing the drug with the greatest potential to cause adverse events (generally, this is the NSAID). Titrate dose down to lowest effective dose, and you may want to consider stopping the NSAID and reserving it for acute pain episodes. Reassessments should happen at regular intervals during NSAID dose reductions - - we choose every 2 – 4 weeks. If we reduce/remove the NSAID and pain returns, we return to the next higher dose for long-term use. Next, target gabapentin reduction (see gabapentin details above). Most human patients never eliminate gabapentin, so don’t sweat this. We never remove gabapentin, Adequan®, nutritional joint support, or omega 3 FA’s.
Keys to success

- Create as detailed and personalized a plan as possible
- Write everything down
- Create realistic expectations in dialogue with the client
- Schedule the next reassessment +/- treatment appointment before the client leaves
- Review all medications/dosing, feeding/nutrition at each visit
- Track medication refills (compliance)
- Relish the challenges of chronic pain
- Involve the entire healthcare team

These will be your most rewarding cases and your most committed clients.

Resources
Veterinary Anaesthesia Support Group
www.vasg.org
American Academy of Pain Management
www.aapainmanage.org
American Society of Pain Educators
www.paineducators.org
AAHA/AAFP Pain Management Guidelines for Dogs & Cats 2015
Download at: www.aahanet.org
ISFM & AAFP Consensus Guidelines: Long-term Use of NSAIDs in Cats
Task Force Members:
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Llibertat Real Sampietro, DVM
Sheilah Robertson, BVMS (Hons), PhD, CVA, DACVA, DECVAA, MRCVS
Margie Scherk, DVM, DABVP (Feline Practice)
Polly Taylor, MA, VetMB, PhD, DVA, MRCVS
Download at: http://jfm.sagepub.com/content/12/7/521.full.pdf+html
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The fundamentals of acute pain management mean understanding that treating pain is good medicine, that providing peri-operative analgesia means before, during, and after the surgery, and that multi-modal analgesia is the strategy of choice. Compassionate care, of which CRI is a quintessential example, means giving each client your best effort every day.

“Medicine should be practiced as a form of friendship.” - - Leon Bernard

CRIs are EASY - - MUCH easier than you think it is if you listen to many of the “experts” who seem to do their best to make CRI seem mysterious and achievable only by huge practices or only those with specialists on staff. This is pure bunk!

You do NOT need a syringe pump to do CRI. You do NOT need special IV tubing to do CRI.

You DO need a precision IV infusion pump to do CRI correctly. You DO need to have IV fluids flowing with the CRI drug (in its own standard dilution bag with its own IV line and its own precision IV fluid pump) “piggy-backed” in order to overcome the hydrostatic pressure within the vein (22ga x 1 ½” needle into IV line port). This is especially true during the post-op period when flow rates are exceptionally low.

STANDARD DILUTIONS of CRI drugs are the KEY. Make life easy with Excel spread sheets with all the calculations made in 0.2 # (or 0.1 kg) increments of patient body weight.

Examples from real life

CRI fentanyl

Use this drug pre-op, intra-op, and post-op. The standard concentration is 0.05 mg/ml (50 μg/ml). The pre-op bolus is drawn from the standard concentration vial.

Pre-op bolus dose

Dogs & cats – 0.005mg/kg (5 μg/kg) IV

For intra-op and post-op CRI, create a STANDARD DILUTION in small bags of saline (0.9%), and then simply vary the flow rate according to the patient’s size and need.

Intra-op dosing

Dogs & cats – 20 - 40 μg/kg/hr

May go as high as 60 μg/kg/hr or more depending upon the patient’s need. Remember that pure mu opiates are given to effect.

Post-op dosing

Dogs & cats – 2 - 4 μg/kg/hr using the same standard dilution solution

Adjust the dose up if needed (we have had patients who needed 15 – 20 μg/kg/hr post-op - - remember to effect)

Create a STANDARD DILUTION of fentanyl (and other drugs) for CRI use and then simply vary the flow rate as needed.

• Fentanyl standard dilution:
  o mg/ml

Case example for fentanyl CRI

• 6.6# cat = 3 kg

• Pre-op bolus:
  o 5 μg/kg X 3 kg = 15 μg
  o 15 μg / 50 μg/ml = 0.3 ml of standard concentration fentanyl

Intra-op

20 μg/kg/hr X 3 kg = 60 μg/hr

Using the standard dilution of 0.01 mg/kg, a 100ml bag contains 10 μg/ml (the bigger the patient - - dog or cat - - the bigger the bag you will need), so 60 μg/hr / 10 μg/ml = 6 ml/hr. Increase the flow rate if the cat needs more fentanyl to achieve the desired analgesic result.

Post-op

2 μg/kg/hr X 3 kg = 6 μg/hr
We use the standard dilution, 100 ml bag which contains 10 μg/ml, so 6 μg/hr / 10 μg/ml = 0.6 ml/hr. Again, adjust the flow rate as needed.

Case example for ketamine CRI
The standard concentration is 100 mg/ml. Create a STANDARD DILUTION of 0.5 mg/ml. The pre-op bolus dose is generally taken from the DILUTED ketamine.

- Bolus dose:
  - Dogs & cats – 0.5 mg/kg
- Intra-op dose:
  - Dogs & cats – 10 μg/kg/minute
- Post-op dose:
  - Dogs & cats – 2 μg/kg/minute

Case example for ketamine CRI

- 13.2# cat = 6 kg
- Use the 0.5 mg/ml STANDARD DILUTION (1 mg = 1000 μg)

**Pre-op bolus**
- 0.5 mg/kg X 6 kg = 3 mg
- Standard dilution bag contains 0.5 mg/ml ketamine, therefore 3mg = 6 ml bolus

**Intra-op**
- 10 μg/kg/min X 6kg = 60 μg/min; 60 μg/min X 60 min/hr = 3600 μg/hr;
- 3600 μg/hr / 1000 μg/mg = 3.6 mg/hr;
- 3.6 mg/hr / 0.5 mg/ml = 7.2 ml/hr

**Post-op**
- 2 μg/kg/min X 6kg = 12 μg/min; 12 μg/min X 60 min/hr = 720 μg/hr;
- 720 μg/hr / 1000 μg/mg = 0.72 mg/hr;
- 0.72 mg/hr / 0.5 mg/ml = 1.44 ml/hr
- Simply adjust flow rate up or down as needed to modify dose

CRI lidocaine (dogs, NOT cats)
The standard concentration is 20 mg/ml. Create a standard dilution of 4 mg/ml. There is no bolus dose, and the intra-op and post-op doses are the same:

- 50 μg/kg/min
- This is ½ the CRI dose to control cardiac dysrhythmias

We use lidocaine CRI during any abdominal procedure in dogs as it seems to be especially useful for visceral pain. Combine it with fentanyl (or morphine) CRI and ketamine CRI

**Practice tips**
1. Create spreadsheets in Excel to lower the risk for miscalculations of flow rates
2. Use increments of 0.2# (or kg), use the standard dilutions described above, and have Excel calculate flow rates based on the appropriate intra-op and post-op dosing
3. Simply multiply flow rates to increase the delivered dose if needed

**CRI standard bag dilutions**

**Fentanyl 0.01 mg/mL**

- 25mL Bag
  - 25mL X (0.01mg/mL) = 0.25mg / (0.05mg/mL) = 5.0mL Remove 5.0mL of saline and replace with 5.0mL Fentanyl.
- 50mL Bag
  - 50mL X (0.01mg/mL) = 0.50mg / (0.05mg/mL) = 10.0mL Remove 10.0mL of saline and replace with 10.0mL Fentanyl.
- 100mL Bag
  - 100mL X (0.01mg/mL) = 1.0mg / (0.05mg/mL) = 20.0mL Remove 20.0mL of saline and replace with 20.0mL Fentanyl.
- 250mL Bag
  - 250mL X (0.01mg/mL) = 2.5mg / (0.05mg/mL) = 50.0mL Remove 50.0mL of saline and replace with 50.0mL Fentanyl.
- 500mL Bag
  - 500mL X (0.01mg/mL) = 5.0mg / (0.05mg/mL) = 100.0mL Remove 100.0mL of saline and replace with 100.0mL Fentanyl.
- 1000mL Bag
  - 1000mL X (0.01mg/mL) = 10.0mg / (0.05mg/mL) = 200.0mL Remove 200.0mL of saline and replace with 200.0mL Fentanyl.
### Ketamine 0.5 mg/mL

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<th>Concentration</th>
<th>Total Concentration</th>
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<td>25mL Bag</td>
<td>0.5 mg/mL</td>
<td>12.5mg</td>
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<td>Remove 0.12mL of saline and replace with 0.12mL Ketamine.</td>
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<td>50.0mg</td>
<td>100mL X (0.5mg/mL) = 50.0mg / (100mg/mL) = 0.50mL</td>
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<td>Remove 0.50mL of saline and replace with 0.50mL Ketamine.</td>
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### Lidocaine 4 mg/mL

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<th>Calculation</th>
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<td>4 mg/mL</td>
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<td>25mL X (4mg/mL) = 100mg / (20mg/mL) = 5.0mL</td>
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<td>Remove 5.0mL of saline and replace with 5.0mL Lidocaine.</td>
</tr>
<tr>
<td>50mL Bag</td>
<td>4 mg/mL</td>
<td>200mg</td>
<td>50mL X (4mg/mL) = 200mg / (20mg/mL) = 10.0mL</td>
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<td></td>
<td>Remove 10.0mL of saline and replace with 10.0mL Lidocaine.</td>
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<td>4 mg/mL</td>
<td>400mg</td>
<td>100mL X (4mg/mL) = 400mg / (20mg/mL) = 20.0mL</td>
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<td></td>
<td>Remove 20.0mL of saline and replace with 20.0mL Lidocaine.</td>
</tr>
<tr>
<td>250mL Bag</td>
<td>4 mg/mL</td>
<td>1000mg</td>
<td>250mL X (4mg/mL) = 1000mg / (20mg/mL) = 50.0mL</td>
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<td></td>
<td>Remove 50.0mL of saline and replace with 50.0mL Lidocaine.</td>
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<td>4 mg/mL</td>
<td>2000mg</td>
<td>500mL X (4mg/mL) = 2000mg / (20mg/mL) = 100.0mL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Remove 100.0mL of saline and replace with 100.0mL Lidocaine.</td>
</tr>
<tr>
<td>1000mL Bag</td>
<td></td>
<td>4000mg</td>
<td>1000mL X (4mg/mL) = 4000mg / (20mg/mL) = 200.0mL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Remove 200.0mL of saline and replace with 200.0mL Lidocaine.</td>
</tr>
</tbody>
</table>

### Morphine 0.9 mg/mL

<table>
<thead>
<tr>
<th>Volume</th>
<th>Concentration</th>
<th>Total Concentration</th>
<th>Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>25mL Bag</td>
<td>0.9 mg/mL</td>
<td>22.5mg</td>
<td>25mL X (0.9mg/mL) = 22.5mg / (15mg/mL) = 1.5mL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Remove 1.5mL of saline and replace with 1.5mL Morphine.</td>
</tr>
<tr>
<td>50mL Bag</td>
<td>0.9 mg/mL</td>
<td>45.0mg</td>
<td>50mL X (0.9mg/mL) = 45.0mg / (15mg/mL) = 3.0mL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Remove 3.0mL of saline and replace with 3.0mL Morphine.</td>
</tr>
<tr>
<td>100mL Bag</td>
<td>0.9 mg/mL</td>
<td>90.0mg</td>
<td>100mL X (0.9mg/mL) = 90.0mg / (15mg/mL) = 6.0mL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Remove 6.0mL of saline and replace with 6.0mL Morphine.</td>
</tr>
<tr>
<td>250mL Bag</td>
<td>0.9 mg/mL</td>
<td>225mg</td>
<td>250mL X (0.9mg/mL) = 225mg / (15mg/mL) = 15mL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Remove 15mL of saline and replace with 15mL Morphine.</td>
</tr>
<tr>
<td>500mL Bag</td>
<td>0.9 mg/mL</td>
<td>450mg</td>
<td>500mL X (0.9mg/mL) = 450mg / (15mg/mL) = 30mL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Remove 30mL of saline and replace with 30mL Morphine.</td>
</tr>
<tr>
<td>1000mL Bag</td>
<td></td>
<td>900mg</td>
<td>1000mL X (0.9mg/mL) = 900mg / (15mg/mL) = 60mL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Remove 60mL of saline and replace with 60mL Morphine.</td>
</tr>
</tbody>
</table>
Study after study consistently reports that more than 80% of pet owners think of their pets as children. There are more cats than dogs as pets now, and this means job security for us! Our moral imperative is to advocate on behalf of a being that cannot advocate for itself.

Pain, according to the IASP definition, is an unpleasant and emotional experience associated with actual or potential tissue damage. The definition goes on to state that the inability to communicate in no way negates the possibility that an individual is experiencing pain and is in need of appropriate pain relieving treatment. Pain is a complex and multifaceted experience. There is a sensory-informational component, an emotional dimension (suffering aspect), and a cognitive-evaluative component (attention, previous experience, perceived threat to individual). In people, pain is what THE PATIENT says it is because humans can self-report. As for pain in animals, pain is what WE say it is — we assess our patients by proxy. There is tremendous individual variability both among patients and observers. There is no one “right” answer.

Nociceptive pain is transient pain in response to a noxious stimulus. Inflammatory pain is spontaneous pain and hypersensitivity to pain in response to tissue damage and inflammation. These are both considered “adaptive” pain. “Maladaptive pain”, on the other hand, is represented by neuropathic pain - - spontaneous pain and hypersensitivity to pain in association with damage to or a lesion of the nervous system - - and functional pain - - hypersensitivity to pain resulting from abnormal central processing of normal input. It was Clifford Woolf in the *Annals of Internal Medicine* who articulated these two overarching categories of pain. It is important to understand that pain is a spectrum and that pain can (and will) morph from adaptive to maladaptive if it is not appropriately managed.

Wind-up involves sensitization of nociceptors, and peripheral and central pain pathways, in response to a barrage of afferent nociceptive impulses resulting in expanded receptive fields and an increased rate of discharge. This is what we need to try to avoid.

Patient pain assessment is highly individual and variable for both the patient and for the observer. In our assessment, we must consider the reason and context for the patient’s pain. A good pain scoring system must be based on behavior, species specific, and must be influenced by the type and intensity of pain the animal is experiencing. The ideal pain scoring system would have the following characteristics:

- Clearly defined assessment criteria
- Suitable for all observers
- Simple and quick to use
- Sensitive
- Useful tools for intervention
- Identified strengths and weaknesses
- Validated in the cat (because cats are NOT small dogs!!!)

For the record, we still do not have an ideal pain assessment system…

Pain induced behavioral changes include:

- Loss of normal behaviors
- Lack of grooming
- Decreased appetite
- Decreased water intake
- Lack of movement
- Decreased interactive behaviors

Are you dealing with an aggressive cat? Think about pain!

Data suggest that @20% of cats across all ages are dealing with OA, yet 20% of cats in veterinary practices are not being treated for OA. You can’t treat what you don’t see, so we must look for pain, keep an open mind, localize it, identify the source if possible, and make a treatment plan.

This pain palpation examination is adapted from the human pain arena, referenced and refereed, and is part of the training of human practitioners as the technique for identifying tender points in a diagnosis of fibromyalgia. It appears in the veterinary literature in an article titled, “Managing chronic maladaptive pain” in *Clinician’s Brief*, August 2011 (Downing). This is a technique we have used at The Downing Center for nearly 10 years with excellent reproducibility.

Perform your pain palpation systematically and the same way each time. Use 4kg of pressure at each palpation site. Use the fleshy part of P3 (NOT the fingertip). Begin in the paraspinals at the base of the occiput and proceed to the base of the sacrum. Palpate the paraspinals at approximately each spinal segment, and don’t forget the base of the tail. Palpate the circumference at base of neck by
the hands of the clock - - 10 & 2, 9 & 3, 8 & 4. Palpate caudal to scapulae and at the T/L junction the same way. Next palpate the lateral lumbar muscles segment by segment, and then the iliopsoas muscle bundle starting at the T/L and proceeding to the L/S. Squeeze the proximal quadriceps between the flat of the thumb and the lateral surface of the index finger (P2 & P3). Perform joint ROM from toes to torso, and then finish with the head and face. Return to the areas generating a reaction and evaluate them with additional palpation and/or ROM to better identify and characterize the presence and the nature of the pain.

Teach, drill, and practice, practice, practice and include your entire staff. It IS possible to create consistency of assessment within your practice!

Resources
ISFM & AAFP Consensus Guidelines: Long-term Use of NSAIDs in Cats
Task Force Members:
Andrew H Sparkes, BVetMed, PhD, DECVIM, MRCVS
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Margie Scherk, DVM, DABVP (Feline Practice)
Polly Taylor, MA, VetMB, PhD, DVA, MRCVS
Download at: http://jfm.sagepub.com/content/12/7/521.full.pdf+html
AAHA/AAFP Pain Management Guidelines for Dogs & Cats
Download at: www.aahanet.org
Non-Pharma Options for Feline Pain: Nutrition, Nutraceuticals, and Rehabilitation

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For pain in animals, pain is what WE (humans) say it is. There is tremendous individual variability among both patients and observers. There is not one “right” answer. Pain is complex and scientifically intriguing, clinically challenging, and easy to overlook (especially in cats). For us to improve the treatment of feline pain, it means making changes in what we currently do.

The fundamentals of chronic pain management mean understanding that treating pain is good medicine, and that multi-modal management is the strategy of choice. The most common application of nutrition & nutraceuticals in pet pain is among feline patients with chronic maladaptive pain. These are the patients who benefit most from a multi-modal approach to their pain. OA is the number one cause of chronic pain in cats – approximately 20% of dogs AND CATS across ALL ages have OA. One study reveals that 90% of cats over 10 years of age have radiographically evident OA. Market research reveals that approximately 30% of dog owners identify bone and joint problems as an issue, and it is the 7th most common canine claim submitted to VPI®. Feline claims lag due to the difficulty of identifying feline patients in pain.

Food/nutrition

Putting together a multi-modal pain management strategy for a cat is like building a pyramid with a firm, broad foundation. Our patients need to eat something every single day, so nothing is easier than prescribing daily intake that makes a positive contribution to medical care and patient well-being. Weight loss and management are the single most important adjunctive pain management tools for chronic/ maladaptive pain, and are acknowledged as the most critical physical rehabilitation techniques as well. Overweight and obesity impact joints with OA and increase the severity of OA symptoms. Weight loss alone has been demonstrated to decrease the risk of OA development, slow the progression of existing OA, and to relieve pain from OA - excellent studies in humans, and ongoing studies in animal patients. Clinically, these ideas ARE being born out in canine and feline patients.

For weight loss success we MUST follow the science to recommend the best nutrient profile for the job. Clients need to be educated that over-the-counter pet foods will NOT do the job. Clients do NOT understand that OTC diets labeled “light” are NOT significantly calorie-restricted. This means well-intentioned pet owners are seduced by marketing to believe they are doing something useful for the pet. Our obligation is to educate our clients so that they may make FACT-based decisions, not FANTASY-based decisions. At the moment, Hill’s Prescription Diet Advanced Metabolic Weight Solution provides the strongest science coupled with the strongest/best results for body condition normalization.

Prescribe SPECIFIC meal size AND frequency, and DO NOT BE DECEIVED BY THE “FEEDING GUIDE” PORTIONS! The portions therein are ALWAYS too high to achieve the necessary results. Prescribe a SPECIFIC snack list. Clients WILL “snack” their pets, so consider green beans, broccoli, cauliflower – fresh or frozen (NOT canned). These are Point® value “0” in the Weight Watchers® point system.

Schedule no-charge weigh-in appointments with the client and pet at 3 – 4 week intervals. Make the next weigh-in appointment at each scheduled weigh-in or other assessment. Pain patients will be presented for regular pain reassessments, so their weight should be recorded at each of these visits as well.

Consider interactive food toys and dishes for kibble delivery to slow down eating. Have your long-term nutritional profile in mind when embarking on this weight-loss strategy to transition once weight is normalized. Muffin tins make GREAT and CHEAP interactive food toys for cats.

Remember that our genetic profile lays the foundation for our physical reality, health, wellness, and potential to develop disease. The EXPRESSION of a genetic trait is influenced by interaction between the genome and environmental factors. We now know that food/nutrition is one of the most important environmental factors that influence genomic expression. Nutrigenomics is the science of how nutrients affect health at the genomic level, and nutrients serve as dietary signals to the systems that influence gene and protein expression. Step one is to determine the genomic expression difference between healthy and diseased individuals, and step two is to identify nutrients/nutritional profiles that alter genomic expression in the diseased individuals to more closely resemble the healthy individuals. Controlled studies can confirm the anticipated outcomes.

The future of nutrigenomics promises identifying genomic differences in aging and certain disease processes. Research is underway to identify which nutrients can influence genomic expression in beneficial ways. Think of these as “functional foods”. This science raises interesting questions/possibilities about our future ability to manage or even prevent disease via “functional foods”. Will drugs become obsolete?

We also have a nutritional opportunity to interrupt the progression of OA. OA progression creates a cascade of events and effects: Physical stress on joint – chondrocyte damage – activates degradative enzymes – cartilage matrix damage – structural failure.
We need to interrupt the degradation. EPA helps control joint inflammation & blocks degradative enzymes. Research demonstrates the down-regulation of the genes responsible for cartilage degradation with high levels of EPA. A low ratio of omega-6/omega-3 FAs reduces inflammation in and around joints. A joint support nutrient profile should have several important characteristics including:

- High levels of EPA
- High levels of ALA (EPA precursor)
- Low omega-6/omega-3
- L-carnitine (maintain optimum body weight)

Make a long-term nutritional plan at the beginning and articulate the plan in the medical record and to the client right away. Keep these patients on the radar to keep them on track nutritionally. Follow the science and evidence when choosing nutritional profiles for painful patients, and don’t forget to consider any and all relevant co-morbidities when choosing your nutrient profile. Some painful patients have metabolic issues that “trump” their joint disease. Should the patient have a metabolic profile that precludes using a joint-support food, you can still pay attention to joint health via nutraceuticals and a disease modifying agent (e.g. PSGAGs)

**PSGAGs**

Adequan® remains the gold standard (NOT the equine formulation) of PSGAGs. PSGAGs are DMAOs – disease modifying agents of osteoarthritis – made from an extract of cow lung and trachea that is then sulfated. They provide the body with the building blocks of cartilage – molecules that bind to cartilage components. The exact mechanisms of action are not completely known, but PSGAGs have indirect anti-inflammatory effects. They assist the body in the repair of cartilage damaged by the consequences by OA and work best when the body is still in motion and the joints are still in use.

This reflects extra-label use in cats - - 2 mg/# SQ 2 X per week for 4 weeks, weekly for 4 weeks, then twice per month indefinitely.

**Omega 3 FAs**

There is clear evidence that high levels of EPA accomplish two important functions in the joint – decreasing inflammation in and around the joints, and down-regulating the genes responsible for the degradative enzymes that lead to cartilage damage. Flax seed oil is NOT an effective source of EPA for cats. EPA and DHA are both found in fish oil. We need to supplement EPA/DHA (both are omega-3s) at a high enough level to “bottom-load” the omega-6/omega-3 ratio to reduce inflammatory mediators. There is a wide range of canine doses quoted - - 20 – 75 mg/kg/day EPA - - I use the same dosing range for cats because we do NOT yet have the same level of high quality data for cat joints. Based on OA studies, we use 50 - 75mg/kg/day PO of EPA divided BID. Both Nordic Naturals® Omega-3 Pet oil (138 mg/ml EPA) and Nutramax® Welactin (125 mg/ml EPA) are manufactured in alignment with pharmaceutical standards. We need to be able to count on specific mgs of EPA and DHA per dosing unit (capsule or ml). Currently no capsules are available for pets with a high enough concentration of EPA/DHA to make dosing reasonable. Most cats are willing to have these liquids top-dressed on their portion-fed kibbles.

The research is very compelling about the general anti-inflammatory effects of omega-3 FAs, although the human research is more advanced and broad-based than the current published studies in dogs/cats. In human arena, cardiovascular benefits, immune system support, joint health, renal disease, cancer, dermatology, allergies, cognitive function, neuropathy, and possibly diabetes mellitus. Check out [www.omega-research.com](http://www.omega-research.com)

Please forgive the canine emphasis of the following studies:


results suggest that dietary fish oil may exert beneficial effects on synovial fluid matrix metalloproteinases (MMP) and tissue inhibitors of MMP-2 (TIMP-2) equilibrium in the uninjured stifle of dogs with unilateral CCL injury.

The future of omega-3 FAs remains ahead, and nearly daily, new studies are published about the importance of omega-3 FAs in both wellness and preventing illness. There is more research in store for animals patients.

**Microlactin**

Microlactin is a milk protein concentrate from the milk of hyper-immunized cows – hyper-immune milk factor (HIMF) – and inhibits inflammation in many animal models. It appears to be effective regardless of the etiology of inflammation with no evidence of GI irritation. It works by a difference mechanism than NSAIDs or corticosteroids, and the first data about the anti-inflammatory activity of milk was disclosed in 1981. Pharmacological studies have illuminated the following microlactin actions:

Activate macrophages, inhibit neutrophil migration, inhibit neutrophil adhesion, inhibit infection-induced inflammation, inhibit arthritis, suppress edema (rat model), inhibit auto-immune disease

Microlactin appears to have a very selective mechanism that blocks cytokines which contribute to the perpetuation of inflammation. It modifies the biological response to inflammation by changing the response of cytokines and neutrophils. It alters the signaling to neutrophils that “calls” them to the sites of inflammation. Neutrophils then do not release the destructive enzymes that perpetuate the inflammatory process. While it exhibits much the same efficacy profile as NSAIDs, it employs a different mechanism, so it does not share the NSAID AE profile.

Microlactin can be used safely in dogs, cats, and horses, and the dose range in dogs and cats is 30 - 50 mg/kg PO BID. It takes time for maximal effects – initial effects are generally seen within 4 – 7 days with maximal effects at 10 – 14 days. During weeks 1 – 3, overlap it with the NSAID or steroid. After week 3, continue microlactin for long-term anti-inflammatory activity.

**Glucosamine/Low molecular weight chondroitin**

We are still waiting for evidence of definitive benefits from glucosamine to be demonstrated in controlled, well-designed clinical trials. Low molecular weight chondroitin may have a positive effect in a percent of patients, but unfortunately, we cannot predict who will and who will not respond. In 2006, the results were published from the Glucosamine/chondroitin Arthritis Intervention Trial (GAIT) - - see the NIH website. This was the first large-scale, multicenter clinical trial in the US to test glucosamine and chondroitin sulfate for knee osteoarthritis. It evaluated glucosamine and chondroitin sulfate separately and in combination and was coordinated by the University of Utah, School of Medicine.

The study was designed to test short-term (6 months) effectiveness of glucosamine and chondroitin sulfate in reducing knee OA pain in a large number of participants.

Key results - - the positive control (celecoxib) provided statistically significant relief. Overall, there were no significant differences between other treatments and placebo. A subset of subjects with moderate-to-severe pain reported statistically significant relief with glucosamine combined with chondroitin sulfate compared with placebo. Researchers considered these findings preliminary and recommended confirmation through further studies. For participants with mild pain, glucosamine and chondroitin sulfate together or alone were not effective.

This reflects the veterinary experience as some patients some seem to benefit, others do not. Be mindful of your recommendations. Low molecular weight chondroitin may be the key for the “responders”. Provide follow-up to modify your plan if this tool is not effective.

**Avocado unsaponifiables (ASU)**

ASU is an extract made from avocado and soybean oils and has been shown in clinical studies to have beneficial effects on OA. In two studies over 3 months (knee & hip OA), the results revealed that patients who took ASU daily decreased their NSAID use. ASU took at least two months for improvement, but in the long-term studies there were no positive results. Are we seeing improved joint structure versus pain relief? Clearly more long-term studies are needed.

ASU seems to complement effects of other ingredients. For example, ASU plus LMW chondroitin may be more effective than glucosamine and LMW chondroitin sulfate alone at decreasing the expression of several inflammatory mediators.

Pro-inflammatory gene expression in chondrocytes and monocyte/macrophages is inhibited by the combination of avocado soybean unsaponifiables, glucosamine, and chondroitin sulfate, Au RY, Au AY, Rashmir-Raven AM, Frondoza CG, Proceedings, 34th Annual Conference Veterinary Orthopedic Society 2007,57.

There has been an explosion of information within past decade, yet our understanding of all these complex factors still in its infancy. The preliminary science is very exciting because it means more and more “tools” for our pain toolboxes! Be careful to make data-driven recommendations, and stay tuned!

**Rehabilitation**

Fortunately for cats, ALL of the rehabilitation techniques that we use in dogs can (and SHOULD) be adapted for use in cats. This INCLUDES the use of hydrotherapy in the underwater treadmill. Don’t be bashful about utilizing any and all of the most commonly
leveraged rehabilitation techniques - - cryotherapy, moist heat, stretching, ROM, joint mobilization, hydrotherapy, therapeutic laser - - for painful cats who can benefit. Tailor your treatments to fit the cat’s needs and the cat’s preferences.
Pain and Fear in Felines: Linked More Often Than You Think
Robin Downing, DVM, DAAPM, DACVSMR, CVPP, CCRP
The Downing Center for Animal Pain Management
Windsor, CO

Divinum Est Opus Sedare Dolorem (Divine is the Work to Subdue Pain) -Galen

Always approach feline pain from a comprehensive perspective. Begin at the beginning with a thorough examination that includes a neurologic exam, soft tissue palpation, joint ROMs, and gait assessment. Include a metabolic profile so as not to miss important co-morbidities.

Treat the treatable - - and treat all the treatable. Make a plan and work the plan, and recognize that chronic pain is best addressed from a MULTIMODAL approach, and it is no longer appropriate simply to throw an NSAID at the patient. Break the pain cycle as quickly and effectively as possible before initiating physiotherapy/tissue manipulation. Multimodal management of chronic pain means multi-tasking, and the client is an absolutely essential partner in the process, or the process is doomed to fail.

Creating a fear-free experience for cats is a huge part of our obligation to them!

Pre-exam medication options

Buprenorphine
- 0.05mg/kg
- Delivered by owner at home @ 1 hour before the visit
- Be sure to explain HOW to deliver it into the cheek pouch
- It will NOT mask chronic cat pain!

Gabapentin
- 100mg PO @ 1 – 2 hours pre-exam
- It will NOT mask chronic cat pain!

Some cats do best with BOTH gabapentin AND buprenorphine. Acepromazine (1mg/ml) – 0.01mg/kg + hydromorphone (2mg/ml) – 0.05mg/kg - - same syringe & delivered SQ
Deliver as cat arrives, wait 20 minutes, will NOT mask chronic pain!

So, what is the relationship among pain, stress, and distress? While animals do not anticipate or fear their own DEATH, they most certainly DO anticipate and fear PAIN, rightly attempting to avoid pain whenever possible. The pain cats may choose to avoid may include the following:
- IBD
- OA
- Periodontal disease

Pain, anxiety, stress, and distress can become a self-perpetuating cycle.

Let me share some cases

Coco Chanel
- Ragdoll, FS, 5kg, 10 yrs
- Reclusive, impossible to pet, non-interactive with other cats
- Never seen when company came to the house
- Veterinary visits under general anaesthesia
- Biopsy confirmed IBD
- Liquid, projectile diarrhea
- Occasional vomiting
- Easily angered

Sybil
- DMH, FS, 3.2kg, 15 yrs
- Chronic herpes
- HATED car travel
- Poop, pee, and puke in the carrier with every veterinary visit

Ganache
- Siamese cross, MC, 6kg, 5 yrs
- Should weigh 5kg
- Aggressive with other cats in household
• Anxious/aggressive at veterinary visits

Flower
• At rescue:
  • DSH, FS, 7.3 kg (16# !!!), 9 yr
  • Could not be touched
  • Attacked visitors to home
  • Mats over 80% of body
  • Excoriated perianal/perivulval areas
• Now:
  • 3.4 kg (7.9#) (Hills Metabolic Advanced Wt Sol®)
  • Gregarious, interactive, playful

Rooney
• DMH, MC, 2.8kg
• CRD
• OA – lowback, L/S, SI joints
• 21½ YEARS OLD!
• Pain, Anxiety, & Fear (oh my!)

With unacceptable behaviors (“bad actors”), ALWAYS think about pain FIRST! Remember that anxiety exacerbates pain, and pain exacerbates anxiety. Look at the WHOLE patient. Ask LOTS of questions and LISTEN carefully to clients for clues. Ask for pictures and videos. Adequate resources are paramount, but comfort is critical. It is not enough to offer one or two fear-free techniques. Reducing fear may require reducing pain.
Palliative care and hospice care for pets is a relatively young discipline in veterinary medicine. The very first guidelines for end-of-life care were just created in late 2015. The foundational principles have been extracted from human hospice and palliative care. There are critical differences between human and pet hospice and palliative care - specifically, the option/obligation for humane euthanasia for our animal companions. Humane euthanasia should NEVER be withheld from a dying companion animal who deserves it.

Palliative care, hospice, end of life care, and death (either via euthanasia or death without intervention) is a spectrum, and it may take hours to complete the arc from beginning to end. It may actually take weeks to months to complete the journey to death.

Human “hospices” were originally charitable places for travelers to find rest and shelter, most commonly travelers heading to shrines and holy places. Hospice for the terminally ill emerged during the 11th century and was overseen by religious orders (most commonly nuns/sisters). The focus really shifted to the dying in the 19th century thanks to Dame Cicely Saunders, an activist nurse who founded the St. Christopher’s Hospice in south London. Now, more than 100 countries offer hospice care to their citizens.

Hospice is supportive care in final phases of terminal disease. Hospice recognizes that death is a part of life and it avoids aggressive interventions. The prime directives of hospice and palliative care are pain management, comfort care, and quality of life. Hospice is a philosophy of caring and NOT necessarily a place. Hospice can be delivered anywhere. Palliative care is considered an aspect of hospice care. Recently there has been a greater emphasis in human medicine on palliative care.

Hospice in pets was first formally discussed and articulated in the 1980’s by Dr. Eric Clough. Dr. Alice Villalobos, who created the QoL Scale for pets, calls this “pawspice”. There has been a development of multiple formal pet hospice programs and facilities since 2000. Hospice for pets is NOT a substitute for humane euthanasia. A so-called “natural” death is often an agonizing and painful struggle. Ongoing QoL evaluation INVOLVING A VETERINARIAN is a fundamental key to the successful delivery of hospice, palliative, and end-of-life care for cats. Much planning, forethought, and honest communication is needed. The overarching pet hospice priorities include:

• Provide the dying cat with most reasonable and acceptable QoL as end of life approaches
• Support and sustain the family-cat relationship until the very end
• Remain in relationship with the family throughout and beyond the cat’s death

Life-limiting disease brings us to the end-of-life. The concept of “hospice” kicks in as life draws to a close. Before the actual end-of-life, it is “palliative care” that we consider. To palliate means to focus on and mitigate the symptoms of disease without intention to cure the particular condition. Technically, many different diseases are “palliated” rather than cured:

• Diabetes mellitus
• Diabetes insipidus
• CRD
• CHD/CHF
• Addison’s Disease
• Cushing’s Disease
• Systemic cancers

As soon as life-limiting disease is diagnosed, it is time to open the dialogue about the arc on the way to the end of life, addressing prognosis, treatment options, and the potential adverse events associated with various treatment and management options. Most cats will experience multiple morbidities as they age, so the key to high-quality palliative care and end of life experience is achieving balance among various conditions. Be sure to diagnose ALL of the relevant conditions, set priorities among them, and create a management plan that addresses all the issues. It is important to target synergy among the chosen treatment modalities. Pain management is always the number one priority, and the goal is neither to hasten death nor prolong the dying process. Recognize and respect the significance of quality, meaningful time between the cat and the family. Honor the cat’s will to live (and respect when that will is no longer present).

Advanced treatment options are now commonplace which is generally a boon for older cats, but is certainly a complication for cat owners. Delivery of cat hospice (and palliative care) is as individual as the family involved, and there is no one “right” answer. It begs the question, “Is there a difference among palliative care, hospice care, and end-of-life care?” Not really… Think of this as a continuum of care, and the care options will change over time. Patient needs will escalate over time, and the best palliative care is flexible at its core. When we apply palliative care techniques, we need to create a personalized plan for the patient that is based on current illnesses, considers any and all co-morbidities, is based on anticipated symptom progression and emergence, and considers client circumstances and resources.
Arrange for 24 hour care for these families. What will happen if there is an after-hours emergency? Create a document for the client that explains the palliative care/hospice focus. We want to avoid unnecessarily heroic interventions. Articulate, outline, and prioritize treatment and management options. It is critical to provide alternatives and options whenever possible and practical. The dying process is disempowering to the family, so providing choices is VERY empowering. Discuss all appropriate management and treatment options independent of finances and allow the client the freedom to choose what they can afford. Consider the cat’s willingness to cooperate with oral medication and provide alternatives whenever they are needed (e.g. injectable meds vs. oral). Anticipate and minimize medication side effects whenever possible. Pay attention to nutrition. E-tubes are NOT heroic measures for most patients who need them! E-tubes make nutritional support and medication easy by providing easy access to the GI tract.

Help the client modify the home environment appropriately. This means careful questioning and careful listening to the answers. Create non-skid floor surfaces - - area rugs are often more trouble than they are worth. Interlocking foam floor squares may be more effective. Modify access to stairs, modify access to slick floors, provide mobility devices, and maintain access to family activities.

In the home environment, provide easy access to water and food. Use low-sided litter pans or potty pads sprinkled with litter. “Stay-dry” bedding/fabric, orthopedic or memory foam, and temperature regulation are all important considerations. Allow the cat to choose favorite locations, including both indoor as well as outdoor “hang-outs”. The cat should be contained at night or when no one is home. This is all about keeping the cat safe.

Provide demonstration of various techniques - - video or in person, and with the actual patient whenever possible. Match the team member to the client, and supplement written information with pictures whenever possible. Have the client repeat the technique in front of a veterinary team member. If needed, have medications compounded for ease of delivery. Do your homework! Some medications cannot be compounded (e.g. amlodipine).

Provide a list of medications, how they are supplied, how they are given, the frequency, and how medications should be stored. Provide a list of potential side effects for each medication. Use “pill minders” when possible. Create for clients a medication checklist to prevent medication errors. Perform a medication review at every single visit.

End-of-life care does not end at the “end of life”. Emotional support for the client/family is critical, and emotional support must BEGIN at the diagnosis of life-limiting disease. We need to recognize and address the grief of remaining pets. Be able to recognize need for referral to a grief/bereavement specialist. Palliative care is not about giving up nor is it care of “last resort”. It is a kinder, gentler, modified approach to standard care. Be mindful of palliative care techniques that have the potential to undermine the HAB. It may be appropriate to consider having veterinary team members make house-calls for some treatments. For cats who resent or resist travel to the veterinary practice, consider home visits by trained staff. Also, veterinarians can evaluate some of these patients by way of video streaming, Skype, etc. You may want to consider partnership with a local housecall veterinarian. A key to success is consistency of ongoing care coordination.

Therapeutic nutrition means using food as medicine. Nutrition may prolong and improve the quality of day-to-day life. Positive nitrogen balance enhances medication efficacy. Most of the time it is better to eat something than nothing. Some palliation is more aggressive in the short-term - - e.g. tumor-reduction surgery, palliative radiation, placement of feeding tube, short hospitalizations to re-stabilize. Short-term interventions can lead to very long-term benefits. Prepare for the worst, and expect the best. Some palliative care/hospice patients will only live a short time after their life-limiting diagnosis. Other cats may actually “graduate” from hospice.

Be knowledgeable and enthusiastic about alternatives to death whenever appropriate. Help the client to make fact-based decisions rather than fear-based decisions. Help clients to make guilt-free decisions about care as well as about the timing of euthanasia.

Resource
Veterinary Clinics of North America: Small Animal Practice
Palliative Medicine and Hospice Care
May 2011, Volume 41, Number 3
Pharma and Feline Pain: Making the Best Choices
Robin Downing, DVM, DAAPM, DACVSMR, CVPP, CCRP
The Downing Center for Animal Pain Management
Windsor, CO

Our Moral Imperative: To advocate on behalf of a being that cannot advocate for itself...

Acute pain
Acute pain may be planned (surgery) or unplanned (trauma), varies in severity (which dictates the intensity of our pain management strategy), may ALSO involve dealing with chronic/maladaptive pain, and we MUST recognize that a multi-modal approach provides us the opportunity to create a rational plan based on specific tissue targets.

Surgery patients
These patients provide the greatest opportunity for us to make a difference, and we now know that the best pain management strategy begins BEFORE the surgical insult. This decreases the need for induction agents, inhalant agents, and post-op pain medications. This provides greater comfort for the patient, sets the stage for optimal healing, and using targeted therapy means making rational choices about the areas of the nervous system we need to address and how to get there. We need to prevent the unrelenting afferent barrage of nociceptive signals which leads to peripheral and central sensitization, and “windup”. General anaesthesia ONLY causes unconsciousness and does NOTHING to move us toward the goal of analgesia. Without proper intervention (e.g. pre-emptive analgesia), the pain experience upon awakening, will be WORSE than before becoming unconsciousness.

Preventing windup
Local anesthetics prevent windup by blocking pain signals completely. In addition, opioids obtund windup and N-methyl-D-aspartic acid (NMDA) receptor antagonists block central sensitization e.g. ketamine as a CRI

Pre-op
Combining a sedative and opioid (hydromorphone & acepromazine) potentiates the effects of the opioid (but ace is NOT analgesic - - this is VERY important!). Consider carefully the use of anticholinergics (we use ONLY PRN). Keep your feline patient warm!

Butorphanol has NO PLACE in a perioperative protocol!
• Pre-med, the analgesic effects are GONE just in time for the first stroke of the scalpel
• Diminishes effectiveness of any subsequent delivery of pure mu opiate
• Expensive (by comparison) to “real” analgesics
• Still in use due to complacency

Immediately pre-op:
Position your patient to have an optimal surgical experience, with minimal pain and optimal healing, so at induction, take 5 – 10 minutes to help your patient by pre-oxygenating @ 4 – 6 L/min via mask while you are placing the catheter & then during induction. Create a SMOOTH induction with propofol + midazolam. It is PAST time to retire ketamine/valium! It creates a ghastly experience for cats!

Last step pre-op - - local anaesthesia
Place your local anaesthetic BEFORE the surgery begins! Infusing local anaesthesia AFTER a surgery/after an incision is made, is precisely like locking the barn door after the horse is gone. Depending upon the nature of the procedure, the local may be best administered via epidural, intra-articular injection, specific nerve block, etc.

Continuous rate infusion (CRI)
This is “continuous” rather than “constant”, and in fact, it changes with the patient’s needs as well. It is an extremely effective way to manage pain intra- and post-op. CRI dramatically reduces the inhalant concentration needed for maintenance. CRI is really the only place for ketamine any longer (not for induction)

Intra-op
Inhalant anaesthesia DOES NOT provide analgesia. Our pre-meds need a long enough duration to cover our surgery time, but for longer procedures, consider an epidural and/or CRI. Good surgical techniques assist with pain management by minimizing the trauma to tissues. Whatever you do, don’t forget to keep your patient warm!

Post-op
Continue CRI’s if they are in place, and titrate the dose over time as the cat recovers and regains strength. Do not stop CRIs abruptly. Begin your NSAID at this time if appropriate for the patient. There is NO compelling evidence to support giving the NSAID BEFORE the surgical event. Regularly assess patients and revise the pain plan accordingly. Opioids post-op can be pulse-dosed for patients who do not need or receive CRIs.

Until now – regular injectable buprenorphine was used IV or TM, and the doses quoted in the literature are:
• 0.03mg/kg – 0.05mg/kg
The dosing interval depends in large measure upon level of pain, and this formulation requires a fairly frequent dosing interval.

Simbadol® (Zoetis) is really a game-changer. It is an excellent complement to an NSAID.

- **Dose:**
  - 0.24mg/kg SQ ONCE daily for 24 hours of pain relief
  - Can administer the first dose 1 hour pre-op (label)
  - We deliver it at the end of our procedures
  - For use once daily for up to 3 days

- **Be careful - -**
  - Do not get it on your mucous membranes
  - Do not use in moribund cats
  - Be careful in cats with hepatic disease
  - If cats are sensitive to buprenorphine or other opioids, they may be sensitive to Simabol®

- Do NOT dispense for client administration at home
- Give the patient the benefit of the doubt when assessing for pain.
- Pain is easier to prevent than to reverse.
- An NSAID paired with an opioid better than an NSAID alone.
- The therapeutic & side-effects of opioids are dose-dependent.
- Don’t be afraid to let the patient sleep post-op provided they have stable vital signs.
- Reduce any potential adverse side effects by choosing drugs and doses to meet the patient’s needs.
- Transition to oral meds for going home.

**NSAIDs**

- Choose according to the best fit for the patient
- Determine how long the patient will benefit from their use
- If using meloxicam in cats be sure to PRECISION dose
- There is NOT compelling evidence to demonstrate that NSAID should be given BEFORE the anaesthetic event.
- NSAIDs can increase the risk of complications.

**Tramadol**

NO SAFETY OR EFFICACY DATA IN CATS! Do not use this drug!

**Gabapentin**


Sedation is the dose-limiting side effect - - non-linear pharmacokinetics. So far there is only one post-operative study about gabapentin in veterinary medicine (canine amputees), and the drug failure was predictable due to the very low and the very short time it was used… opioids will also fail if the dose is too small. Clinically, in “big pain” cases, gabapentin improves outcomes in pain scores and function – both short and mid-term. The dose range is quite wide - - 5 – 20 mg/kg PO BID – TID. There will be effects within 24 hours – consistent effects within 3 – 5 days – post-op for 14 – 21 days.

Remember to use physical medicine options to enhance pain management post-op. You can use these techniques immediately post-op as well as at home when appropriate. Don’t forget general nursing care - - keep the patient warm, turn regularly, keep bladder empty, keep clean of soiling. Use cryotherapy over the surgery site to decrease pain & swelling. Build your “pain management pyramid” based on several factors:

- The anticipated pain resulting from the procedure
- Routine castration < routine OHE or cryptorchid castration < toe amputation < large tumor removal < total ear ablation < limb amputation or other orthopedic procedure
- Give the patient the benefit of the doubt
- Layer your modalities to meet the patient’s needs both immediately post-op and as recovery proceeds

**Resources**

Veterinary Anaesthesia Support Group
www.vasg.org
American Academy of Pain Management
www.aapainmanage.org
American Society of Pain Educators
www.paineducators.org
Resource
AAHA/AAFP Pain Management
Guidelines for Dogs & Cats - 2015
Download at: www.catvets.com
When considering pain sensation, we MUST remember that all pain is not created equal!!!

Nociception is where it all begins. The reception, conduction, and central nervous system processing of nerve signals is generated by the stimulation of nociceptors. This is the first step in the physiological process that leads to the perception of pain. We are taught to consider “types” of pain.

**Transient/physiologic pain**
This is pain that is elicited by activation of nociceptive transducers in the absence of any tissue damage. Transient/physiologic pain plays a protective role, occurs on a daily basis, and does not require medical attention. It actually protects us and preserves us. It plays an important evolutionary role.

**Acute pain**
This is pain that is elicited by substantial injury and includes surgery, trauma, chemical insult, radiation. This is the normal, predicted physiological response to an adverse chemical, thermal or mechanical stimulus, and is the initiation phase of an extensive, persistent nociceptive and behavioral cascade triggered by tissue injury. If either unmitigated or UNDER=managed, it can set the stage for a perpetual state of self-sustaining pain. This is pain that demands our careful attention.

**Chronic pain**
This is pain that persists for longer than the expected time frame for healing or pain associated with progressive, non-malignant disease. We have been taught to consider it to be a distinct category of pain.

Finally, we consider maladaptive pain
This is pathologic pain - - pain that has exceeded its protective usefulness. It can be an overwhelming experience and is often associated with tissue injury incurred at the time of a surgery or injury that is either untreated or UNDER-treated. The results can include hyperalgesia and allodynia. Another type of specific pathologic pain can occur in the cancer patient, and may be the result of a primary tumor, metastatic disease, or the toxic effects of chemotherapy and radiation.

It is time to consider the fact that pain is a spectrum from adaptive to maladaptive pain - - “good” pain vs “bad” pain - - pain that helps the patient survive vs pain as disease. (Clifford J Woolf, Annals Intern Med 2004) Maladaptive pain includes neuropathic pain (spontaneous pain and hypersensitivity to pain in association with damage to or a lesion of the nervous system) and functional pain (hypersensitivity to pain resulting from abnormal central processing of normal input). Maladaptive pain is associated with “wind-up”, the sensitization of nociceptors, and peripheral and central pain pathways, in response to a barrage of afferent nociceptive impulses resulting in expanded receptive fields and an increased rate of discharge.

Patient pain assessment is highly individual/variable both for the patient and for the observer. We must consider the reason and context for the patient’s pain. AND, of course we must remember that cats are NOT small dogs!

One important way to make pain a priority in your practice, educate your team, educate your clients, become members of the IVAPM. The next step is to pursue pain management certification as a Certified Veterinary Pain Practitioner.
How to Assess and Address Linear Foreign Bodies, 
Plus What to do About Abdominal Trauma in Your Feline Patients

Howard Seim III, DVM, DACVS
Colorado State University
Fort Collins, CO

Key points
• Don’t let the sun set on a GI obstruction
• Always look under the tongue in suspected linear FB
• Multiple enterotomies may be needed
• Surgery prior to mesenteric perforation improves prognosis dramatically

If you would like a copy of the illustrated version of these notes on CD and a video of this surgical procedure on DVD, go to www.videovet.org and click VideoVet or contact videovet@me.com.

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

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

Radiography
Definitive diagnosis is based on characteristic findings on survey and contrast radiography. Survey radiographs may reveal plicated bowel bunched up in one quadrant of the abdomen. Due to its plicated nature, air accumulation in the bowel lumen forms a characteristic "tapered enteric gas bubble". Three or more tapered gas bubbles are diagnostic for linear foreign body.

Presurgical treatment
Surgery for the removal of linear foreign bodies should be accomplished as soon as possible. Presurgical preparation of patients diagnosed early and in good health include an intravenous catheter, maintenance fluids, replacement of fluid loss from vomiting and dehydration, and antibiotics prior to abdominal exploratory. Patients that present in septic shock (i.e., perforation, peritonitis, severe dehydration) should be treated with a graduated replacement of fluids (as needed up to 90 cc/kg IV) and four quadrant antibiotics (cefoxitin, ampicillin and enrofloxacin, or gentamicin and ampicillin). Electrolytes (chloride, potassium, sodium) and acid-base evaluation are helpful in presurgical management. When fluid losses have been replaced and shock therapy instituted the patient is anesthetized for abdominal exploratory.

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

Once the proximal end is released, the extent of the linear foreign body is evaluated, and 2-3 subsequent jejunal enterotomies are performed to remove the remainder of the foreign body.
Care is taken to remove the linear foreign body in segments short enough that further cutting of the mesenteric border of the intestine does not occur during removal, yet long enough to perform a minimum number of enterotomies. These numbers and distances vary with the type and length of linear foreign body involved. The mesenteric border is examined carefully for evidence of perforation. All linear foreign bodies should be removed to the level of the ascending colon. Colotomies are not necessary, as once the linear foreign body is in the colon it can be passed with little danger of causing obstruction.

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

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

Patients with multiple mesenteric perforations that cannot be sutured without severely compromising bowel viability should undergo massive bowel resection. Remember, you can successfully resect 60 - 70% of the small intestine and have a nutritionally acceptable animal. If the client is willing to treat their dog or cat with an acid blocking agent, this resection can be expanded to a 75 - 80% small intestinal resection.

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

Prognosis
Prognosis for patients with linear foreign body is directly related to the presence or absence of bowel perforation at the time of surgery. Patients without preoperative perforation have an 85% chance of survival while those with preoperative perforation have only a 50% chance of survival. This survival rate further reinforces the importance of early diagnosis and surgical treatment.
Relieving Distress and Obstruction: Cystic and Urethral Calculi Excision
Howard Seim III, DVM, DACVS
Colorado State University
Fort Collins, CO

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

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

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

Diagnosis

Clinical presentation

Signalment
There is no age, sex or breed predisposition.

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

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

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

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

Radiography
Survey radiographs may show presence of radiodense calculi in the urethra and/or urinary bladder as well as a distended urinary bladder. Occasionally, radiolucent calculi occur and can only be visualized using retrograde contrast cystourethrography. Careful radiographic evaluation of the kidneys and ureters should be done to rule out renal and ureteral calculi.

Ultrasoundographic examination
Exam of the bladder, ureters, and kidneys may be helpful in diagnosis of cystic, ureteral, or renal calculi.

Differential diagnosis
Any disorder causing urinary obstruction, including urethral neoplasia, granulomatous urethritis, urethral stricture, and urethral trauma. Definitive diagnosis is based on clinical signs, inability to pass a catheter, and evidence of calculi on survey or contrast radiographs.
Medical management
Immediate care
In animals with complete obstruction long enough to cause azotemia, temporary urinary diversion is provided by performing a prepubic cystostomy (see technique described below) or frequent cystocentesis (i.e, tid to qid). Azotemia is treated with crystalloid IV therapy prior to calculus removal.

Urethral catheterization of a female cat
See the DVD for a detailed video description of this technique (www.videovet.org).
  • Female urethral catheterization is easier than male
  • Use a closed ended tom cat catheter
  • Ventral recumbancy is recommended
  • Pass the catheter with no evidence of resistance

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

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

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

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

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

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

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

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

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

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

Calculus removal

Retrograde hydropulsion: See the DVD for a detailed description of this technique. This technique should result in an 80-85% success rate for retropulsing urethral calculi into the urinary bladder!

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

Anesthetize the animal, extrude the penis and pass the lubricated urinary catheter in the urethra up to and against the calculus. Place a dry gauze sponge around the extruded tip of the penis and occlude the penis around the catheter by squeezing it with thumb and finger.

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

a) During injection, the calculi and urethra are lubricated by the saline/lubricant mix while the viscosity of the mixture (i.e., KY jelly and saline) encourages the calculus to dislodge and become retropulsed into the urinary bladder.

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

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

Surgical treatment

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

Preoperative management

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

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

Anesthesia

Routine general anesthesia is performed in patients that present acutely without signs of azotemia. Azotemic, shocky patients with moderate to severe biochemical abnormalities should be treated as described above until these abnormalities return to normal.

Surgical anatomy

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

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

Positioning

Patients are positioned in dorsal recumbancy for retropulsion, cystostomy tube placement and routine cystotomy.

Surgical technique

The surgical technique varies depending upon the procedure chosen and are described in detail below:

Retropulsion

The technique for retropulsion of urethral calculi is described above in medical management.

Percutaneous cystostomy tube placement

Occasionally, it may be necessary to perform a percutaneous antepubic cystostomy to decompress the urinary bladder whilst treating a severely azotemic and metabolically derranged patient until they become a better anesthetic and surgical risk.

Surgical technique

The patient is sedated and placed in dorsal recumbancy. A 3-4 cm incision is centered between the umbilicus and pubis. Subcutaneous tissues are dissected to expose the ventral midline (i.e., linea alba). A 2-3 cm incision is made in the linea alba and the bladder wall located. A 12–14 French Foley catheter is advanced through a skin incision 2-3 cm lateral to the abdominal incision, tunneled in the subcutaneous tissue and brought into the abdominal cavity at a location just lateral to the midline abdominal incision. A purse string suture is placed in the bladder wall at the proposed site of Foley catheter placement with 3-0 monofilament absorbable suture. A 1 cm
incision is made into the bladder lumen and the Foley catheter advanced. The purse string suture is carefully tightened to create a water tight seal but not to tight as to create bladder wall necrosis. The bladder wall is pexied to the abdominal wall at the point of entry of the Foley catheter with 3-0 monofilament absorbable suture in a simple interrupted pattern. The abdominal wall is closed in a routine fashion. The cystostomy catheter is held in place with a Chinese finger trap friction suture technique using #1 monofilament nonabsorbable suture and attached to a closed collection system to avoid urinary tract infection. The cystostomy tube remains in place until the patient is ready for definitive surgical treatment.

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

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

See the DVD for a detailed video description of the surgical procedure. Prior to surgery a urethral catheter is passed, if possible. After a routine castration, an elliptical incision is made around the scrotum and penis. Then the subcutaneous tissues are dissected to expose penile urethra. The penile urethra is dissected free from surrounding connective tissue. The ventral attachment of the pelvic urethra to the pubis (i.e., ishiocavernosus m.) is identified and transected. The penile urethra is freed from its connective tissue attachments to the pelvic floor using blunt digital dissection.

After incision of the urethra, the glistening urethral mucosa is identified. 5-0 nonabsorbable monofilament suture with a swaged on cutting or taper-cut needle is recommended by the author. The first urethrostomy suture is placed at the dorsal aspect of the bulbourethral glands penile dissection can stop. The penis is catheterized and the urethral orifice identified. An incision is made from the penile urethra to the pelvic urethra to the level of the bulbourethral glands using a Stevens tenotomy scissor or Iris scissor. The urethral orifice at the level of the bulbourethral glands is generally of large enough diameter to accept the flange of a tomcat catheter.

Alternating sutures from dorsal to ventral are placed until approximately one half of the penile urethra has been sutured to skin. The remainder of the penis is amputated and the subcutaneous tissue and skin are closed routinely.

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

Cystotomy
See the DVD for a detailed video description of this procedure. After successful retropulsion of urethral calculi into the bladder the catheter used to retropulse calculi is passed into the urethra and bladder and left in place. Leaving a catheter indwelled in the urethra ensures that remaining cystic calculi will not roll back into the urethra during patient transfer to the surgery suite and during patient prep. The patient is place in dorsal recumbancy with the hind legs tied gently cranially to slightly elevate the pelvis. A folded towel is placed under the pelvis to help support it in this position. This positioning will greatly facilitate exteriorizing the penis during surgery.

Just prior to aseptic preparation of the abdomen a soft, 5-8 French red rubber catheter or feeding tube is placed into the prepuce and a prepuceal lavage is performed using 20 cc of a 1:50 dilution of 1% betadine solution and sterile saline. This aseptically prepares the penis and prepuce so they can remain in the surgical field throughout the cystotomy procedure.
A caudal midline incision is made from umbilicus to pubis. The bladder is exteriorized and examined. Stay sutures of 3-0 suture are placed in the apex and neck of the bladder. A scalpel blade is used to penetrate the ventral aspect of the bladder and enter the lumen. The ventral cystotomy incision is extended with Metzenbaum scissors. The bladder should be opened from apex to neck to allow proper visualization of bladder mucosa and easy retrieval of all calculi. Stay sutures are placed on each side of the incision at its midpoint to facilitate visualization of the bladder interior. Large hemostats are placed on the stay sutures to help retract the bladder margins. A cystotomy spoon is used to scoop the bladder neck for calculi. This is performed several times. When no more calculi can be removed with the spoon, digital palpation of the bladder neck is performed to identify presence of further calculi. If calculi are palpated further attempts are made to retrieve them. Once no more calculi can be spooned or palpated the indwelling urethral catheter placed after retropulsion is removed.

Next, a 3.5 - 5 French urethral catheter is placed in the penile urethra (i.e., retrograde). A dry sponge is used to grasp the extruded penis to create a water tight seal around the catheter. A 35cc syringe filled with sterile saline is injected through the catheter under moderate pressure. The stay sutures on the bladder incision are retracted to enable visualization of the bladder lumen during lavage. Suction or intermittent spooning is performed during lavage in an attempt to identify and remove any remaining stones. After several high pressure lavages and negative results in obtaining stones, the catheter is placed from the bladder lumen into the bladder neck and pelvic urethra (i.e., normograde). Lavage is once again performed in an attempt to identify and remove any remaining stones. After several lavages and negative results, the catheter is advanced until it can be seen coming out of the penile urethra. The catheter is run back and forth in the urethra several times (‘urogenital floss’) to ensure there are no remaining calculi (i.e., gritty feeling while passing the catheter).

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

Urinary catheters of various sizes, Foley catheter, head lamp light source, 2X loupes, ophthalmic instruments, 4-0 or 5-0 monofilament nonabsorbable suture material.

Postoperative care and assessment

Postoperative care varies depending upon procedure performed:

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

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

Perineal Urethrostomy: An Elizabethan collar should be considered, especially in patients that may be prone to self-mutilation. Patients should be kept quiet and away from other animals. An indwelling urinary catheter placed routinely postoperatively is NOT necessary following an uncomplicated urethrostomy.

Prognosis

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

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

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

**How to Place an Esophagostomy Tube, Plus a Novel Approach to Perineal Urethrostomy**

Howard Seim III, DVM, DACVS

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**Key points**

- feeding tubes should not pass the LES
- “if the gut works, use it”
- learn how to do a Chinese finger trap friction suture
- keep a column of water in the tube between feedings

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

**Esophagostomy**

**Indications**

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

**Contraindications**

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

**Advantages**

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

**Disadvantage**

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

**Placement technique**

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

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

**Eld esophagostomy tube placement technique**

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

Curved Carmalt hemostate technique

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

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

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

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

Complications

Complications associated with esophagostomy tube placement include early removal by the patient or vomiting the tube. No significant long-term complications have been reported (e.g., esophagitis, esophageal stricture, esophageal diverticulum, or subcutaneous cervical cellulitis). Reflux esophagitis can occur from improper tube placement (i.e., through the lower esophageal sphincter) or esophageal irritation from the tube itself. Mid-esophageal placement of silicone rubber tubes greatly reduces the incidence of esophageal injury and eliminates reflux esophagitis.
The Innards and Outs of Feline GI Surgeries
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Key points
- intestinal sutures should engage at least 3 - 4 mm beyond the cut edge of serosa and placed
  - no further apart than 2 mm
- always handle bowel wall with atraumatic technique
- examine the integrity of your anastomosis visually
- 50 - 60% of the small intestine of cats can be resected

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

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

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

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

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

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

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

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

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

The following tips may prove helpful when performing an intestinal anastomosis (see the anastomosis video clip for detailed description of tips below):

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

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

**Postoperative care**

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

**Feeding**

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

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

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

**Complications**

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

A presumptive diagnosis may be accomplished by the following:

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

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

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

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

**Prognosis**

The overall prognosis for uncomplicated GI surgery is excellent. The surgeon must pay attention to detail when suturing any hollow viscus organ.
When and How to Repair a Diaphragmatic Hernia
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Key points
• Most diaphragmatic hernias are not acutely life threatening
• Suture the hernial rent from dorsal to ventral
• Use a one layer simple continuous appositional suture pattern for closure
• Evacuate all thoracic air prior to closure

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

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

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

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

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

The muscular part is divided into the pars lumbalis, a pars costalis on each side, and the pars sternalis, all of which with the exception of the lumbar portion, have a uniform thickness of 2-3 mm in cats. The pars lumbalis of the diaphragmatic musculature is formed by the right and left diaphragmatic crura, the right crus being considerably larger than the left. Seen from the abdominal cavity each crus of the diaphragm is a triangular muscular plate whose borders give rise to the tendinous portions. The pars costalis on each side consists of fibers radiating from the costal wall to the tendinous center. The pars sternalis is an unpaired medial part unseparated from the bilateral costal portions.

The diaphragm domes far into the thoracic cavity, and its costal part lies on the medial surface of the last few ribs and costal arch (when tears occur here, the costal arch can be used in the repair). The stomach and liver attach by ligaments to the concave peritoneal surface of the diaphragm.

Diagnosis
Diaphragmatic hernia is generally diagnosed via thoracic and abdominal radiographs. Classic findings on thoracic radiographs is loss of the diaphragmatic line, air filled visceral structures in the thoracic cavity, loss of lung fields.

Abdominal radiographs may reveal a lack of abdominal viscera. Classic thoracic radiographs of a patient with a peritoneo-pericardial diaphragmatic hernia shows a large, round pericardial sac. Occasionally, air filled viscera can be identified in the pericardial sac. Patients that present with an acute traumatic diaphragmatic hernia (e.g., hit by a car) may have a massive hernia with abdominal contents replacing most of the patients respiratory capacity.

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

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

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

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

Surgical procedure
See the DVD for a detailed video description of this technique. When an extra pair of hands is unavailable for retraction, a Balfour self retaining retractor is a helpful piece of equipment; large Gelpi retractors work well in cats. Using the abdominal approach, an incision is made from xiphoid to pubis. Once the peritoneal cavity is opened, the diaphragm is exposed and the situation evaluated. Some hernias, especially in the area of the dorsal attachments of the crura and the aortic hiatus are not easily visualized; therefore, this area should be carefully inspected even when another laceration is present. The herniated contents are replaced in their proper position and inspected for damage.

Using large sponges or laparotomy pads moistened with warm saline, the liver and bowel are retracted caudally. Visualization of the cranial quadrant of the abdomen can be facilitated by removing the viscera from the abdominal cavity and placing it on a moistened laparotomy sponge. The diaphragmatic tear is now more easily visualized so that a careful examination of the thorax can be done both visually and manually. All thoracic fluid should be aspirated.

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

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

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

Air can be evacuated from the chest using several techniques.

1. Prior to tying the last knot of the hernial closure, a carmalt forceps is placed in the hernial rent between two sutures and gently spread open to allow access to the thoracic cavity. The lungs are inflated so as to fill the thoracic cavity. The carmallts are removed and the last suture tied to provide an air tight and water tight seal.
2. After hernial rent closure a needle or plastic intravenous catheter is placed through the diaphragm and into the thoracic cavity. Thoracic cavity air is evacuated using a syringe.
3. Needle thoracentesis is performed after the procedure is complete.
4. A 12 - 14 French feeding tube is brought into the peritoneal cavity through a paramedian stab incision in the cranioventral body wall. The tube is passed through the diaphragmatic rent between to sutures just prior to its final closure. Make certain that all fenestrations in the tube are beyond the diaphragm. The diaphragmatic rent closure is then completed around the tube. With the use of a 3-way stop cock and 60 cc syringe, air is evacuated from the thorax until a gentle negative pressure is obtained. The celiotomy incision is closed in a routine fashion. When the celiotomy closure is complete, the tube is again aspirated. The patient should then be placed through a series of positional changes.
(ventral recumbency, right lateral recumbency, left lateral recumbency, and dorsal recumbency) while attempting to aspirate air. When negative pressure is obtained in all positions, the tube is gently pulled from the chest and abdominal incision.

5. A 12-14 French diameter thoracostomy tube can be placed at the level of the 10th or 11th intercostal space, tunneled to the level of the 7th or 8th intercostal space and placed through the intercostal muscle and into the thoracic cavity. The patient is then placed through a series of positional changes (ventral recumbency, right lateral recumbency, left lateral recumbency, and dorsal recumbency) while attempting to aspirate air. The tube is removed when the patient has had a negative pressure for 12 - 24 hours.

All patients are monitored carefully for the next six to eight hours. If signs of respiratory abnormalities arise (dyspnea, tachypnea, etc), the right and left hemithorax should be tapped with a needle and syringe.

**Postoperative care**

Post-surgical care includes systemic antibiotics and careful monitoring of the patient's breathing, temperature, and color. Cats should be kept on a warming device for at least 24 hours. Analgesics may be used to relieve patient discomfort, however care should be taken to monitor the effects of various analgesic drugs on respiratory effort. Thoracic radiographs may be taken to evaluate the chest drain and pleural space. [AppData/Local/Microsoft/Windows/Temporary Internet Files/Content.Outlook/YP0G54ES/Figure 06.pdf](../AppData/Local/Microsoft/Windows/Temporary Internet Files/Content.Outlook/YP0G54ES/Figure 06.pdf)

**Summary**

Successful repair of a diaphragmatic hernia depends on careful preoperative and postoperative care of the patient. During the surgical repair, the surgeon must work quickly and effectively to complete the procedure as efficiently as possible.
Cats do not see or experience the world the way we do. In our busy days at the clinic, it is imperative that we take pause and assess how our feline patients interpret their veterinary experience. From the moment the client schedules the appointment to the moment they return home, the cat’s experience can be traumatic and frightening. Understanding natural cat instincts and planning their visit to accommodate for this will improve the visit experience for everyone, especially the cat and client.

In a natural environment, cats are predators AND prey. We frequently think of cats as hunters but forget that they are also hunted. This means that during their veterinary visit, they frequently feel threatened. This is the baseline instinct that can drive many cats’ negative reactions to a visit to the veterinarian.

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

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

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

Routine patterns of behavior
As obligate carnivores and solitary hunters, cats tend to be territorial and find safety in predictability of their surrounding environment. As household members, most clients understand that their cats are schedule-oriented. Cats appreciate consistency, know when mealtime has arrived, and are stressed by disruptions in their regular routines. A visit to the veterinarian is a definitive disruption in this routine. When one considers how stressed clients can become in anticipation of a trip to the vet with the cat, the cat is more likely to anticipate the changes and experience stress well in advance of departure. Assisting our clients in preparation for the veterinary visit can go a long way to reducing the initial visit stress.

Goals for a good veterinary visit
Our goals for a good veterinary visit should include reducing anxiety in clients, patients and staff. Veterinary staff should seek ways for the client and patient to have a positive, productive visit with zero injury to patient, client and staff.

A stress free visit starts at home. The client should be provided with emotional support in person and by telephone or email. The client should be encouraged to stay calm. Provision of the best type of carrier, and instruction to use this correctly is important. Treats, rewards, facial pheromones and necessary medications should be discussed and utilized as needed.

Avoid anticipating behavior in a negative way. It is critical to understand and remember that a patient may have a history of negative behavior in our clinic, but labeling patients as fractious, for example, is not productive in making change to the patient experience. Making positive steps to address this are better than just preparing for the worst. The initial minutes after a ‘bad’ visit should be used to assess what went wrong, understanding how the patient was feeling and how that dictated the patient response. In addition to providing telephone support, the author utilizes medications such as gabapentin and/or buprenorphine or alprazolam for anxious patients. These are prescribed and administered in advance of the veterinary visit.
Address pain prior to the visit
Pain is a major consideration in many of our patients. In a study by Lascelles et al (2010), cats between 6 months and 20 years of age were randomly selected for radiographic assessment for the purpose of detecting lesions consistent with arthritis. In this study, 91% of the cats were shown radiographic evidence of DJD. This was shown to exist with equal frequency in all age groups. This study highlights the need for practitioners to ANTICIPATE pain. A proactive effort to reduce or eliminate pain prior to the visit and handling will make a significant difference in the patient’s experience. The author frequently utilizes gabapentin, and sometimes buprenorphine, in advance of visits in patients with known or suspected arthritis pain. This applies to patients with other types of pain as well.

Restraint: Lightest touch is the strongest hold
During handling of feline patients for any reason, the least amount of handling is best. Most patients do better when they have some control over the situation and are not restrained in any aggressive way. Enhancing the patient environment with dim lighting, quiet and a warm, fuzzy blanket can improve the patient demeanor dramatically. Sitting on the floor with the patient can be helpful, if the examination table is too stressful. Some practitioners do not have examination tables in their feline consultation rooms. Avoiding eye contact is beneficial. Reading patient body language and responding accordingly will ease anxiety. The practitioner should avoid touching the patient if the cat is engaged in sniffing items of particular interest. In this type of environment, cats are more amenable to handling for physical examinations, blood pressure assessments, injections and tissue sampling (blood and urine sampling).

For blood and urine sampling, patient pain should be addressed well in advance. Patient positioning should depend on patient comfort levels. Reduced restraint levels produce better results. Aggressive restraint methods are not ideal. The author does not support the use of scruffing or so-called ‘clipnosis’.

In cases where patients are simply not cooperative for handling, chemical restraint in the form of sedation is best. The alternative is physical restraint. The latter hurts the patient, reduces the success of data collection and puts all involved at risk of injury. The latter also impacts future veterinary visits for the now traumatized patient and client.

Feline friendly practice
Certification with the AAFP Feline Friendly Practice program will assist the veterinary staff and practitioners in understanding and being prepared to interact with the feline species. The certifications are valuable in clinic promotion to existing and potential clients as well.

At the end of each feline visit, the goal is for everyone involved to feel like the experience was positive and productive for feline, client and staff inclusive. Objectives for care should be met without the need for brute force, with an aim to understanding the unique feline senses and how these affect the feline veterinary experience.

References
Cats age rapidly. The domestic cat reaches its prime by 3 to 6 years of age. At 7, the domestic cat can be classified as mature. A 10-year-old mature cat is the human equivalent of a 56 year old. From 11 to 14 years, the cat is classified as a ‘senior’, the human equivalent of 60-72 years of age. After 15 years, the cat is considered geriatric, the equivalent to a human 76-years of age or older.

It follows that if age category changes occur so rapidly, so will health. While in the junior and prime years a cat might get away with seeing the veterinarian once yearly. The senior cat needs more frequent visits. In the space of less than 6 months, a geriatric feline can change from perfectly healthy to diseased and debilitated. Biannual visits are best and should be discussed, recommended, and scheduled with the client. The clinically ill should be seen more frequently as medical needs dictate.

**Feline aging**
Although the risks of certain diseases increases with age, age in and of itself is not a disease. Changes in the patient as noted by the client or the clinician should be investigated thoroughly as they are likely to pertain to disease or poor health. Many conditions are treatable and manageable, particularly if caught early. Avoiding pursuit of diagnostics and care simply because the cat is ‘old’ is not recommended. The value and quality of life at the patient may be impacted positively for years if conditions are diagnosed and treated appropriately.

**Pain**
If cats are masters at hiding illness, they are geniuses at hiding pain. A client may not perceive changes suggestive of pain in their feline friend. Day to day changes may be subtle in their progression, eluding the client’s observations. Some clients may excuse away the changes, citing age as a factor, but not recognizing that the main impetus behind behavior changes is likely to be pain. Monitoring normal patterns of behavior will help detect changes that may be occurring as a result of pain. Having the client note the cat’s mobility pattern, including willingness to jump up or down, as well as litter box usage is key. Clients should be encouraged to make notes about their cat’s activities and behaviors, especially as they age. This way, subtle and gradual changes will not be missed.

**The subtle signs of sickness**
Many practitioners are aware of the ‘subtle signs of sickness’ in cats. We understand that cats are masters at hiding illness. We understand and seek to help our clients recognize what subtle changes can mean with regard to feline health. In addition to being a sign of disease, we also have to recognize these subtle changes as evidence of possible pain.

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

**Condition scoring: Body & muscle**
As cats age, changes in body weight, body condition and/or muscle condition can be the earliest signs noted that disease is present. Assessment and recording of body weight at every single veterinary visit is necessary to detect subtle changes early. Each patient will need to have body condition scoring as well as muscle condition scoring. As cats age, body muscling naturally changes. Cats will undergo decreases in muscling, a natural process referred to as sarcopenia. This needs to be distinguished from the more negative change known as cachexia. Cachexia can indicate the presence of disease, insufficient dietary needs and in particular, insufficient dietary protein.
Disease concerns
Senior and geriatric patients are at increased risk of disease in general. Risks of conditions such as chronic renal disease and hyperthyroidism are known to increase with age. Older patients are also at increased risk of neoplasia, hypertension, cardiac issues and of course, arthritis/degenerative joint disease. Dental disease and pain are common. Observations of unexplained changes in body weight, behavior, appetite, drinking, elimination behavior and grooming need to be addressed by the client and clinician in a timely fashion.

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

Each clinic should develop it’s own program for monitoring and supporting the individual nutritional needs of patients. Registered veterinary technicians are excellent resources for this type of program, and can often handle managing these programs, reporting to the clinician as concerns arise. The senior and geriatric feline should have regular weigh in visits to determine body condition and muscle condition scores. These visits should be conducted at least every 3-4 months, and more often in the clinically ill senior or geriatric feline.

Unique environmental needs
The senior and geriatric feline will have changes associated with their five senses, as well as strength and mobility. These changes will impact environmental needs. Changes in play items and structures, sleeping areas and litter boxes will need to be considered. Litter box locations and wall heights will need to be addressed. As arthritis needs are addressed with pain management and other care, environment changes will reduce the stresses on the musculoskeletal system.

Cognitive changes
Behavioral problems in the geriatric cat may be explained by the presence of disease and pain. Treatment of the disease, and/or treatment of pain will often resolve behavioral changes. Howling may be observed in some cases of hyperthyroidism, as well as patients with hypertension. Changes in elimination, including soiling outside of the litter box can occur with conditions such as diabetes mellitus, renal disease, lower urinary tract disease, hyperthyroidism and neoplasia. Pain can lead to many changes in behavior including, but not limited to, elimination issues, irritability, increased sleeping, howling, decreased grooming and decreased mobility. Regular clinical testing as well as pain management will help identify disease and pain-related causes of behavior changes. In some cases, cognitive dysfunction (CD) may be the primary source behind the behavior changes noted. Although there are no specific diagnostic criteria for CD in cats, ruling out other causes and treating for pain will help the clinician form a presumptive diagnosis. Cognitive dysfunction signs in cats can include disorientation (time or space), altered learning and memory, house soiling, altered interactions with the client, activity changes, sleep pattern changes, alterations in appetite, and/or decreased grooming. Vocalization may also occur.

References
As cats reach their senior and geriatric years, our focus on their health needs to intensify. By now we have established a working relationship with our client over the years of the patient’s life. They recognize that their pet is getting old. However, they do not always understand exactly what changes are going to occur. Above all, the goal of the veterinarian and the client should be to avoid patient suffering.

Changes can occur rapidly. Feline patients over the age of 7 or 8 years of age should be seen for a healthcare assessment every 4-6 months. For the healthy, this can be every 6 months, but for those with chronic health conditions, a move to healthcare assessments every 4 months will be beneficial.

Recording normal behaviors
Clients should be advised to start a journal or notebook to highlight the normal patterns of behavior of their particular cat. Timing of eating, elimination behaviors, sleep, and play, when documented, will act as an excellent resource when attempting to identify changes. This type of recording should begin as early as kitten hood. For the clinician, this journal can also assist when end-of-life decisions have to be made. Quality of life discussions are difficult at best. Knowing the level of changes that have occurred in behavior patterns over time help the client to come to terms with end-of-life decisions.

Pain
Many senior or geriatric patients will be experiencing one or more health conditions. A variety of diseases and conditions will predispose the patient to pain. Even if the patient is apparently healthy, the consideration of pain secondary to arthritis is critical. In a study by Lascelles et al (2010), cats between the ages of 6 months and 20 years of age were randomly selected for radiograph study. Ninety-one percent of the cats had radiographic evidence of degenerative joint disease (DJD), with equal frequency in all age groups. This type of study provides convincing evidence that DJD should not be ignored in cats, and that pain related to DJD can be a significant concern. Clients may actually be observing mobility changes and possibly even lameness, further convincing the clinician that pain needs to be addressed. There are many pain management options available to the clinician. These should be selected based on the patient history, health status and the actual source of pain. The author frequently prescribes gabapentin as a pain medication for cats with arthritis, debilitating disease and moderate to severe dental disease. While chronic use of non-steroidal anti-inflammatory drugs are frequently off-label in the feline species, these can be beneficial as an adjunct therapy. The author frequently uses meloxicam (Metacam) and rodenacoxib (Onsior) for arthritic patients. Other pain medications that the practitioner may consider for various types of pain include buprenorphine, tramadol, or amantadine. Patients with windup pain may benefit from 2-3 days of intravenous fluid therapy with constant rate infusion (CRI) therapy with ketamine, buprenorphine and/or other drugs. Many neutraceuticals are available for feline arthritis. These include omega fatty acid supplements, glucosamine and chondroitin, in liquid, pill or food form. The author frequently utilizes injectable polysulfated glycosaminoglycans (Adequan, Cartrophen) as a successful adjunct to arthritis therapy and subsequent pain relief.

“One of the psychological curiosities of therapeutic decision making is the withholding of analgesic drugs because the clinician is not absolutely certain that the animal is experiencing pain. Yet the same individual will administer antibiotics without documenting the presence of a bacterial infection.” LE Davis, Clinical Pharmacologist, University of Illinois.

Condition scoring: Body weight, body condition & muscle condition scoring
Senior and geriatric patients should be assessed on a regular basis. Practices should develop a recording system for body weight, body condition score (BCS) and muscle conditioning score (MCS). Trends in these values should be observed, with individual patient assessment scheduled at regular intervals throughout the year. While the patient may be seeing the clinician every 4-6 months, the patient should visit with a registered veterinary technicians every 2-4 months for assessment of body weight, BCS and MCS. Trends in these values can be the first indicators of disease or failure to successfully control known diseases. Meeting with a technician for this assessment every 2-4 months keeps the client informed of the patient status, and facilitates the client’s own understanding of body condition as a reflection of health or disease. These visits will also encourage dialogue about dietary concerns. The client may have changed the patient diet, or the patient may be experiencing previously unobserved periods of Inappetence, vomiting or anorexia. These changes will alert the technician to potential problems. The technician can in turn alert the veterinarian, and appropriate, timely follow up can be pursued.
Nutritional needs
The clinician should ensure that the dietary intake of the patient is quantified in detail by the client. Metabolic energy requirements (MERs) should be calculated frequently by the clinician or veterinary technician. Biannual visits with the veterinarian will help detect body condition or body weight changes, but regular visits in between these times should also be considered. A visit every 2-4 months with the veterinary technician for a weigh-in, BCS, MCS and nutritional assessment will go a long way to detecting problems early as well as ensuring the patient is taking in sufficient calories. Veterinary technicians take charge of these types of programs in a most efficient manner. They can easily learn and set up standard protocols for determining MERs. They will quickly become familiar with nutritional guidelines for various foods, both those sold at veterinary clinics and those available over the counter. Ensuring adequate intake is critical in senior and geriatric patients to promote health and proper immune function, as well as to avoid situations of muscle wasting and cachexia due to insufficient protein intake. In addition, when patients are showing signs of weight loss, the MERs can be evaluated to determine if reduced intake is a part of the weight loss dilemma. Quantifying daily intake for cats is a critical piece of knowledge for clients with senior and geriatric cats.

Disease concerns
Increasing age comes with an increased risk of disease. Regular monitoring for evidence of problems includes a regular, thorough physical examination and collection of a minimum data base (MDB). As noted previously, part of every consultation should be a weigh in, as well as BCS and MCS assessment. These values should be compared to previous values in order to identify trends. The physical examination should be meticulous and thorough, as should the discussion of the patient status and history with the client. Even very subtle changes in behavior patterns may be significant of a declining health status. Thorough evaluation of the patient’s eyes, and in particular the retinas, is something that is often overlooked. The retinas can provide early indication of hypertension, and thus their status should be assessed and recorded with every senior feline visit. Blood pressure testing is a critical part of every feline senior or geriatric visit. The clinician should evaluate a MDB for every senior patient. The MDB includes a total thyroid, clinical chemistry, complete blood count and urinalysis. Urinalysis may results may indicate the need for further testing such as urine culture and/or urine protein creatinine ratio. Where renal disease is identified, thorough IRIS staging will target therapies and improve prognosis as well as quality of life.

Unique environmental needs
Senior and geriatric cats have unique environmental needs. This mainly stems from their likely reduced mobility secondary to arthritis, but can also be related to cognitive dysfunction either as a primary or secondary (to other disease) problem. The senior patient may no longer feel comfortable running to the basement to use the litter box. Placement of boxes throughout the house is recommended. A high walled litter box may be viewed as a painful challenge to be avoided. Use of low entry or low walled, uncovered litter boxes is recommended. Assistance with access to higher furniture such as beds and window sills can be accomplished with steps or platforms to reduce necessary jumping heights.

Cognitive changes
There are no specific diagnostic criteria for the diagnosis of cognitive dysfunction (CD) in cats. In many instances, it is a diagnosis of exclusion. The mnemonic DISHA is used as a means of diagnosing CD in dogs (Disorientation, Interactions, Sleep-wake, House-training, Activity). This may be of some use in the diagnosis of feline CD. Therapies for CD are not well-studied in the feline species. Selegiline (Anipryl) has been utilized for the treatment of CD in cats. Nicergoline (Fitergol), Propentofulline, (Vivitonin), oxazepam/orazepam/clonazepam, buspirone and fluoxetine have also been used. Omega fatty acid supplements and other antioxidants may be beneficial. Environmental adjustments should be made to accommodate patient needs. Pain management is a mainstay component of care in senior and geriatric cases of CD.

References
The Vomiting Cat:
A Quirky Feline Trait or a Sign of Disease?
Kelly St. Denis, DVM, DABVP
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Vomiting in the Cat: How much is too much?
Clients and veterinarians often accept that vomiting in cats is a regular occurrence not significant of underlying health problems. This is a particularly common assumption with regard to vomit containing hairballs. Cats spend approximately 25% of their waking hours grooming (Panaman et al, 1981). Ingestion of hair is obviously a natural side effect of this process. The majority of ingested hair passes through the cat’s digestive tract into the feces with no negative side effects (Panaman et al, 1981). Given the large commercial industry built around the ‘hairball’ phenomenon, clients may view hairballs as a normal process. When questioning clients about occurrence and frequency of vomiting during routine examination, veterinarians should inquire separately about the occurrence and frequency of hairball vomit. The answer is sometimes surprising, and may be key to identifying the presence of gastrointestinal disease (GID) in the patient (Cannon, 2013).

Cats that vomit once or twice a year may not be considered to have any specific underlying GID. However, cats that are vomiting more often than twice monthly are significantly more likely to have some baseline underlying GID (Norsworthy et al, 2015). In a study by Norsworthy et al (2015), 100 cats that presented with vomiting more frequently than twice monthly were subjected to abdominal ultrasound, exploratory surgery and intestinal biopsy. Of the 100 cats biopsied, 99 were found to have histologic evidence of intestinal disease. Only 1 patient had normal intestinal biopsies. For many of these cats, the clients had not been concerned about the frequency of vomiting, citing it as a normal result of hairballs, as well as behaviors such as eating too fast.

Where to start: Identifying abnormal vomiting or diarrhea
During routine preventive care examinations, detailed questioning about diet, diet changes, vomiting and hairballs is essential. As noted above, many clients will not consider hairballs noteworthy or mentionable. As a result, without proper questioning by the veterinarian, a patient vomiting frequent hairballs may not be identified. Where clients are not sure about vomiting and/or hairball frequency, a calendar recording system should be recommended. Simple recording of the vomit or hairball on the kitchen calendar, noting frequency, will help the client and the veterinarian document the vomiting frequency. This type of recording is helpful in evaluating response to treatment as well.

A history of abnormal bowel movements should also be investigated. Diarrhea can occur in conjunction with upper GID, or as a manifestation of lower GID. Documentation of stool character, volume and frequency will help elucidate the source of the diarrhea (small intestine versus large intestine versus mixed). Conditions such as inflammatory bowel disease (IBD) can exist as a problem within the upper gastrointestinal, small intestinal, combined small intestinal/large intestinal or solely large intestinal tract. Identification of which intestinal segment is causing the diarrhea is important in identifying which portion of the GI tract is potentially diseased.

Small bowel versus large bowel diarrhea

- **Small:** large volumes, variable frequency, flatulence, borborygmus, melena, steatorrhea, vomiting
- **Large:** small, frequent volumes, tenesmus, urgency, dyschesia, mucus, frank/fresh blood, vomiting

The veterinarian should also carefully question the client to identify evidence of constipation. Difficulty with passage of bowel movements may also be a cause of nausea. The client may have noticed small, hard feces in the litter box. Discussion with regard to what is normal fecal matter in the cat will help elucidate whether the patient is experiencing abnormal feces. During the last two decades, when cats have been fed primarily dry food, clients have come to have an expectation of small, firm feces. In recent years, more cats are being moved to canned diets. As cats consume more water in their diet, the definition of normal’ fecal consistency will need to be changed.

In addition to regular vomiting, the patient may be showing signs of nausea at home that are not obvious to the owner. Cats that have a tendency to be fussy about the food they eat, moving from one type to another for short periods followed by food refusal, are likely experiencing nausea or GI upset. While ‘flavor fatigue’ is an understood observation in the domestic feline species, refusals of new diets may not simply be due to boredom (Little, 2011). Clients may describe cats that go off food entirely for 1-2 days followed by a perfectly normal appetite. This should not be considered to be normal. Clients and veterinarians may notice lip licking, gagging or excessive swallowing at home or during the abdominal palpation. Coughing can be caused by upper respiratory, lower respiratory or GID. Careful history taking will elicit clues about GID and nausea. A video of apparent coughing episodes is helpful.

286
The subtle signs of nausea

- Finicky appetite
- Occasional loss of appetite or anorexia
- Licking of lips
- Gagging/swallowing
- Ingestion of grass to stimulate vomiting

A thorough physical examination of the vomiting cat is also beneficial when characterizing GID. The patient should be observed for signs of lip licking and frequent swallowing. A thorough oral health examination, a critical part of every feline examination, may reveal foreign objects looped under the tongue, oral ulceration or other oral or dental disease that may impact appetite and vomiting.

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

Evidence of low-grade dehydration in the presence of a skin tent, tacky mucus membranes or sunken eyes may be identified. Dehydration may be directly related to frequent vomiting.

The subtle signs of gastrointestinal disease

- Unexplained weight loss
- Evidence of vomiting and nausea
- Evidence of dehydration
- Abdominal pain
- Licking of lips during abdominal palpation
- Small, hard feces in the colon
- Large, firm, feces distending the colon
- Gas in the intestine/flatulence during examination

Careful abdominal palpation is important in the vomiting cat. The abdomen should be examined in quadrants and the patient carefully observed for evidence of nausea or pain during palpation of each quadrant. Cats noted to lick their lips or swallow during abdominal palpation are likely exhibiting signs of nausea. Evidence of pain during abdominal palpation may include very subtle changes. The patient’s face should be monitored closely for evidence of wincing, blinking or other facial expression changes that could indicate pain. The patient may growl or hiss, although this is rare. Guarding of the abdomen during palpation of the painful quadrant(s) may also be observed.

Abnormal findings during the palpation may include evidence of an enlarged liver, distended stomach, thickened/ropy intestines, free-fluid in the abdomen, masses and/or enlarged mesenteric/intestinal lymph nodes.

Formulating a differential list

Establishing a good history in the vomiting patient, as well as performing a thorough physical examination will help refine the list of differential diagnoses. The patient signalment can also provide clues, as can the duration of the vomiting. Acute vomiting in a kitten or young cat can be fairly straight forward, but the cat that has been vomiting intermittently for as long as weeks, months or even years, can be more puzzling.

Adult cats are less likely than kittens to ingest toxins or inappropriate objects, but these still need to be ruled out, particularly in the acute patient.

Obstructive disease causing vomiting in cats can occur as a result of physical obstruction, but may also be a functional issue. Gut motility changes associated with inflammation can, for example, predispose to vomiting.

If the patient is vomiting hairballs, the potential for excess ingestion of hair secondary to a skin condition needs to be addressed. If skin disease is not a contributing factor, then the presence of hair within the vomitus is most likely to be incidental secondary to vomiting for another cause. In rare occasions, hairballs can become obstructive or impeding, and my act as a foreign body causing vomiting (Cannon, 2013).

Differential diagnoses in the vomiting adult and senior cat

- Dietary indiscretion: toxic substance, foreign body
- Skin disease: excessive grooming
- Intestinal accident-intussusception
- GIT stasis/altered motility-diet, stress, pain, dehydration, obesity
- Intestinal parasitism
- renal disease
- hyperthyroidism
- pain
Within any age group, intestinal parasitism needs to be considered. An apparent lack of exposure based simply on an indoor lifestyle does not rule out intestinal parasitism. The presence of GI parasites can complicate the clinical picture, so the possibility of infection should be eliminated using appropriate empirical therapy.

In the vomiting patient over 7 years of age, diagnoses of renal disease, hyperthyroidism, or diabetes mellitus should be ruled out. Neoplasia will also be higher on the differential list in the vomiting senior cat. Any of these diseases can lead include vomiting as a clinical sign. Appropriate testing will rule these conditions in or out.

References
The Vomiting Cat: From Diet to Dexamethasone; Making Therapeutic Decisions
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Symptomatic, targeted and empirical therapies

Dietary
The role that dietary allergens may play in the development of gastrointestinal disease is poorly understood (Jergens, 2012). It makes sense that dietary sensitivity or food allergy could play a role in the development of gastrointestinal inflammation. At the very least, the inflamed gut will have unique challenges digesting complex diets. Dietary changes may be beneficial to the patient with gastrointestinal disease. Changing dietary format, such as dry to canned formulations may improve digestion. The use of veterinary formulations that are easy to digest such as Royal Canin Gastrointestinal forumulas, Hill’s i/d or PVD EN gastroenteric may reduce or in some cases eliminate active gastrointestinal signs. This does not preclude the need for diagnostic testing, but is beneficial in stabilizing the patient and reducing morbidity.

The selection of true hypoallergenic diets may be indicated when dietary allergens are suspected to play a role in the patient’s disease. The decision to pursue a hypoallergenic diet may be based on diagnostic testing, failure to respond to gastrointestinal diets or evidence of concurrent clinical signs known to be associated with food allergy. Large bowel signs are more often observed in patients with food allergy (Jergens et al, 2012). In addition to gastrointestinal signs, cutaneous disease can be a concurrent clinical sign of food responsive enteropathy (Jergens et al, 2012).

Parasiticides
Intestinal parasites need to be considered as a differential diagnosis in any vomiting case. While intestinal parasites may not be causing vomiting, their presence in the gastrointestinal tract may impact digestion and contribute to a worsening of clinical signs. A thorough review of the patient’s deworming history is wise. Empirical deworming, even where fecal testing is unremarkable, is strongly recommended. The clinician should select a broad-spectrum deworming agent to treat the patient for common roundworm, hookworm and tapeworm. These medications should be utilized in a series of treatments in order to eliminate all stages of the parasite life cycle. Recommendations can be found in the Cat healthy protocols http://www.cathealthy.ca/protocols/ and/or Companion Animal Parasite Council (CAPC) website http://www.capcvet.org/capc-recommendations/

Nausea
Anti-emetics may be beneficial to the vomiting patient. Drugs with prokinetic effects should be used with caution in cases where intestinal obstruction has not been ruled out. Gastric acid blockers such as ranitidine and omeprazole are less likely to play a beneficial role in feline patients with gastrointestinal disease.

Appetite stimulants
Appetite stimulants for loss of appetite or anorexia may be beneficial in improving intake, but in the presence of nausea and gastrointestinal inflammation, these drugs are likely to be of little utility until underlying disease is addressed. Mirtazapine is the author’s drug of choice for stimulating appetite. In some cases, cyproheptadine may also have utility in appetite stimulation.

Fluid support
Loss of appetite, vomiting, and/or diarrhea all lead to fluid dehydration. Provision of rehydrating fluids and electrolyte stabilization will reduce morbidity.

Pain management
Patients with gastrointestinal disease (GID) are likely to be experiencing pain as a result of or concurrent to their GID. Cats older than 7-9 years of age are likely to have some degree of arthritis, which may impact morbidity. As the signs of pain in the feline patient can be subtle at best, any conditions identified as potentially painful should be treated as such. Gabapentin, buprenorphine, non-steroidal anti-inflammatories (where steroids will not be employed) may all be beneficial in pain management.

Cobalamin
It has been recommended that all cats with gastrointestinal disease and a serum cobalamin of <300ng/L should receive parenteral supplementation of cobalamin (Ruaux et al, 2005). The current supplementation dosage recommendations from Texas A&M University (TAMU) are 250 micrograms cobalamin SQ weekly for 6 weeks, then one dose after 30 days, and retesting 30 days after the last dose. Evaluation of the clinical signs and cobalamin levels at this stage in treatment will provide some indication of prognosis with regard to GID. Regularly updated recommendations for the usage and monitoring of cobalamin can be found at http://vetmed.tamu.edu/gilab/research/cobalamin-information

Antibiotics
The empirical use of metronidazole or tylosin is sometimes considered (Cook et al, 2008). The success of this approach is hypothesized to occur as a result of either the eradication of an unknown pathogenic bacteria or the alteration of the host response to endogenous bacteria (Cook et al, 2008). Empirical use of antibiotics should generally be avoided, in order to continue responsible use
of these drugs. Where specific infections have been identified, culture and sensitivity patterns should dictate the choice of antibiotic therapy and duration. Follow-up cultures to ensure eradication of infection, should be conducted whenever possible.

**Steroids**
The empirical use of steroids is generally not recommended in any situation in feline medicine. Despite this, it is a frequent occurrence in feline GID patients. Limitations of finances and client willingness to pursue diagnostic biopsy may impact the treatment selection process. Steroid use can be directed as for IBD, but in the absence of a diagnosis, ensuring client understanding of risks and rewards becomes critically important. Steroid usage where a potential diagnosis of small cell or large cell lymphoma have not been ruled out, may decrease patient longevity and reduce choices for therapy should a diagnosis be made later in the course of care. Any steroid usage precludes or limits usefulness of ultrasound or biopsy, as the drugs will change the local inflammatory pattern, thus confounding diagnosis. Clients need to be made aware of this prior to embarking on steroid usage. Where steroids are to be employed, urine culture should be considered prior to drug initiation, in order to rule out occult urinary tract infection.

**Cyclosporine**
Empirical use of cyclosporine is not recommended, but may be considered in cases as noted below.

**Chlorambucil**
Empirical use of chlorambucil is not recommended. In some cases of severe GID where a diagnosis has not been obtained, clinicians may elect to use this chemotherapeutic agent in conjunction with steroid therapy. This is an empirical use of the drug and clients should be made aware of this as well as the potential side effects noted below.

**Inflammatory bowel disease and lymphoma**

**Inflammatory bowel disease**
The non-specific treatments noted above often play a role in therapy for presumed or diagnosed inflammatory bowel disease (IBD) patients. In many instances, some or all of these treatment modalities may have been tried prior to diagnosis with some degree of response.

**Steroids**
Where a diagnosis of inflammatory bowel disease has been made, steroids may be used to in an attempt control, reduce or (rarely) eliminate inflammation. The selection of steroids should be based on the targeted cell type (based on histopathologic diagnosis) and client/patient needs. Dexamethasone may provide a more targeted control of pro-inflammatory T cells and allow reduced dosing frequency. Long-term daily use of this drug is not recommended as the diabetogenic effects may be significant. Prednisolone is the biologically active metabolite of prednisone. In cats, direct administration of prednisolone increases the bioavailable dose, as the feline species is inefficient at converting prednisone to prednisolone. The author does not recommend the use of depomedrol in cats. Budesonide may play a role in some patients, but reduced levels in the circulation will limit the drug’s benefit to patients with concurrent pancreatitis. Cyclosporine may have benefit in some patients, particularly those experiencing notable steroid side effects include a pre-diabetic or diabetic state, as well as steroid-induced hair loss (rare).

**Small cell lymphoma (low grade lymphoma)**
A variety of protocols have been published for the treatment of low-grade alimentary lymphoma (LGL). The majority of these protocols consist of a combination of glucocorticoids and the alkylating agent chlorambucil, usually established on a long term, maintenance schedule of administration. Glucocorticoid treatment can be administered in oral or parenteral forms of prednisolone or dexamethasone. Regardless of the form selected, the initial dosage of glucocorticoid is usually immunosuppressive in nature. For example, one group used 3 mg/kg prednisolone orally every 24 hours initially in treatment of low grade alimentary lymphoma patients (Lingard et al, 2009). The subsequent dose of steroid was tapered down to 1-2 mg/kg body weight every 24-48 hours. Well-established protocols include the concurrent use of chlorambucil at a dose of 15-20 mg/m² orally. The drug may be administered every 1-3 days initially or long-term. After an initial period of frequent administration, the administration frequency may be decreased to 15-20 mg/m² orally every 2 weeks (Stein et al, 2010). High dose, pulse therapy with chlorambucil may also be recommended (Lingard et al, 2009). In this study, cats were treated with 15 mg/m² oral chlorambucil every 24 hours for 4 days every 3 weeks. The use of oral prednisolone and high dose pulse chlorambucil is thought to be effective in producing durable remissions in feline low-grade alimentary lymphoma patients (Lingard et al, 2009). Side effects observed secondary to steroid use may include increased drinking, urination and increased appetite. The main potential side effect of chlorambucil is myelosuppression. Anemia, leukopenia, thrombocytopenia, vomiting and diarrhea may be observed (Plumb, 2011). Withdrawal of the drug is recommended in these situations.

Cyclosporin may play a role in treatment of patients experiencing significant side effects from steroid usage. However, it is currently not recommended in the literature, nor has it been evaluated, as a primary line of treatment for LGL.

**Large cell lymphoma (high grade lymphoma)**
The diagnosis of lymphoma by biopsy is most critical in order to rule out this more aggressive, lymphoblastic form of the disease. Empirical treatment of the cat for IBD or LGL may lead to incorrect therapy of a very aggressive form of the disease. This reduces prognosis significantly. Treatment of high-grade lymphoma (HGL) in cats requires the use of chemotherapeutic protocols including
drugs such as doxorubicin. Several protocols have been published. In some cases, referral is the best option for treatment of HGL, as the use of chemotherapeutics is dangerous and requires special handling as well as aggressive patient monitoring. Treatment of feline HGL with multi-agent chemotherapy protocols has been reported to generate a median remission of 140 to 213 days (Mahoney et al, 1995; Zwahlen et al 1998).

References
The list of differential diagnoses in the vomiting adult and senior feline patient is long and complex (see Lecture 1: The Vomiting Cat. 
A quirky feline trait or a sign of disease). Identifying the cause(s) of vomiting as early as possible will reduce long-term negative
effects. Following physical examination, a decision needs to be made about the pursuit of diagnostic testing. Depending on the
severity and duration of disease, the client and veterinarian may elect to either first pursue a minimum database (MDB) or they may
elect to pursue more extensive tests.

The clinical chemistry will be beneficial in identifying the presence of primary hepatic disease, renal disease or diabetes mellitus.
The results will also provide indication of changes secondary to vomiting, such as electrolyte disturbances.

A complete blood count (CBC) may reveal shifts in white cell parameters suggestive of infection, inflammation, parasitism or
allergy. Anemia may be present as a result of gastrointestinal blood loss. Hematology changes should always be investigated further
by the careful examination of a blood smear. The blood smear should be evaluated by an experienced veterinarian or veterinary
technician. Microscopic cellular changes can provide significant information about the patient’s disease process above and beyond
what the sheer numbers may reveal.

A urinalysis is a critical component of the minimum database. It should not be overlooked. Despite the apparent lack of
connection with gastrointestinal disease (GID) signs, the urine may reveal a number of changes that are relevant to the therapeutic
plan. The urine may reveal evidence of bilirubin, which can indicate liver and/or gall bladder disease. The presence of glucose and/or
ketones in the sample may assist in a diagnosis of diabetes mellitus. Even in the absence of GID-related changes in the urine, a
concurrent problem with urinary tract issues such as crystals or infection will impact the therapeutic plans.

The patient’s Feline leukemia virus (FeLV) and feline immunodeficiency virus (FIV) status should be determined. Consideration
for risk factors associated with acquiring these viruses, as well as previous tests, will determine whether previous negative testing is
adequate. Feline leukemia virus is a known cause of lymphoma in the feline patient, and used to account for a significant portion of
these diagnoses (Cotter et al, 2011). However, with the introduction of vaccination against FeLV, there has been a shift in the type of
intestinal lymphoma most common in cats (Cotter et al, 2011; Louwerens et al, 2005). This shift does not change the value of
knowing the patient’s retroviral status in this or any other disease state, as disease management will be impacted by the presence of
retrovirus infection.

Fecal testing for common parasites can be revealing, but the lack of a positive fecal test does not rule out infection. Fecals tests are
notoriously insensitive, making the argument for empirical deworming in most (all) cases of GID.

Beyond the minimum database
Gastrointestinal profiles are an important part of the vomiting cat ‘workup’. In addition to the minimum database, diagnostic testing
will be enhanced by blood testing for cobalamin (B12), folate, feline specific pancreatic lipase (sfPL) and trypsin-like
immunoreactivity (TLI)

Cobalamin (B12)
Cobalamin is released from food in the stomach, and bound to haptocorrin (Non specific binding, low pH environment). Cobalamin is
released from haptocorrin in the duodenum and bound to intrinsic factor (IF; specific binding, neutral pH environment). In the feline
species, IF is a product of the pancreas. This complex binds to specific receptors in the ileal enterocytes and enters the portal
circulation. Without IF, cobalamin cannot enter the bloodstream and passes out in the feces.

Low serum cobalamin is a common finding in cats with chronic intestinal diseases, pancreaticitc and liver diseases (Ruaux et al;
2005, Simpson et al, 2001; Xenoulis et al, 2008). Cobalamin has an important role in the metabolism of sulfur containing amino
acids, and is a factor in lipid and DNA synthesis (Ruaux et al, 2005; Reed et al, 2007). When cobalamin is deficient, actively
dividing tissues such as bone marrow and enterocytes, are negatively affected (Xenoulis et al, 2005). Cobalamin deficiencies
associated with GID can lead to further health compromise (Xenoulis et al, 2008).

In a study by Simpson et al (2001), cats found to have low cobalamin had been presented with clinical signs such as weight loss,
diarrhea, vomiting, anorexia and thickened intestines. Definitive diagnoses in these patients included IBD, intestinal lymphoma,
cholangiohepatitis, cholangitis and pancreatic inflammation. Cats with intestinal lymphoma were found to have particularly low
levels of cobalamin. In total 49/80 cats with GID had subnormal serum concentrations of cobalamin. Many cats with GID and low
cobalamin had simultaneous presence of disease in the intestine, pancreas or hepatobiliary system, making identification of the cause
of low cobalamin difficult.
Folate
Subnormal concentrations of folate were found in 3 of 5 of the cats with intestinal lymphoma and subnormal cobalamin levels (Simpson et al, 2001). In general, subnormal concentrations of folate can be considered to be indicative of chronic GID. Elevations in folate may also be detected. These changes may be related to disturbances in intestinal bacterial populations, although the phenomenon of small intestinal bacterial overgrowth (SIBO) has not been described in cats (Hall et al, 2011).

Feline specific pancreatic lipase (sfPL)
Assessment of sfPL levels may facilitate the diagnosis of pancreatitis in GID patients. Diagnosis of pancreatitis is helpful in case management. Feline pancreatic lipase immunoreactivity has a reported sensitivity of 54-100% and a specificity of 67-91% (Cosford et al, 2010). In a study evaluating FPLI in comparison to conventional tests, overall sensitivity was 67% and the overall specificity was 91% (Forman et al, 2004). This latter test is now considered a useful serologic marker for the diagnosis of pancreatic disease in cats (Cosford et al, 2010, Xenoulis et al, 2008). The variable sensitivity and subsequent difficulty in ruling out pancreatitis with a normal pancreatic lipase requires consideration when interpreting test results. A normal sfPL/FPLI does not rule out pancreatitis.

Trypsin-like immunoreactivity (TLI) may have some benefit in the diagnosis of pancreatitis in GID cats, as well as the diagnosis of exocrine pancreatic insufficiency (EPI). Trypsin-like immunoreactivity has a reported sensitivity of 33-86% and a specificity of 75% (Cosford et al, 2010). Studies have failed to demonstrate a positive correlation of the concentration of this marker with a diagnosis of feline pancreatitis (Forman et al, 2004). Elevations in TLI may be associated with pancreatitis. Decreases in TLI, concurrent with suggestive clinical signs, are likely to be associated with a diagnosis of EPI.

Imaging
Radiography
Radiography is beneficial in elimination of some differential diagnoses in the vomiting cat. Thoracic radiographs should not be ruled out as necessary. In older cats, the presence of neoplastic lesions within the thorax may be the only identifiable source of vomiting. Abdominal radiographs will be beneficial in identifying some foreign bodies, masses, intestinal accidents, and other gastrointestinal tract changes. Abdominal radiography also offers the opportunity to identify urinary tract disease as a source of pain and discomfort. Close evaluation of skeletal structures may also provide information about the presence of painful arthritic lesions and/or spondylosis.

Ultrasound
Ultrasoundography is quickly becoming a common diagnostic tool in general practice. Ultrasound machines are now more affordable than ever. Successful ultrasound does require training, skill and experience. Use in general practice should be guided by the availability of a practitioner skilled in performing ultrasounds.

Ultrasound imaging is beneficial in identifying GI organ abnormalities (liver, gall bladder, spleen, pancreas). The abdomen can be evaluated for a discrete mass or masses, including evidence of lymph node enlargement. Changes in the urinary tract may be identified. Evaluation of intestinal wall thickness as well as changes in the thickness of the four intestinal wall layers may help identify the presence of intramural disease such as IBD and lymphoma. Destruction of intestinal wall layer integrity as well as thickening of particular intestinal wall layers may be suggestive of certain types of GID. Gastrointestinal luminal contents (obstruction), intestinal accident (intussusception) and motility may be evaluated. Ultrasound changes associated with pancreatitis may be evident (Forman et al, 2004). The sensitivity of ultrasound in the diagnosis of pancreatitis varies (Cosford et al, 2010; Forman et al, 2004; Gerhardt et al, 2001) and may be affected by operator experience. An experienced veterinary specialist should be employed in ultrasound evaluation of the patient’s abdomen.

Endoscopy and exploratory laparotomy: Diagnostic biopsy
Where clinical signs and laboratory studies are strongly indicative of disease such as IBD, lymphoma (diffuse neoplasia), discrete neoplasia, hepatitis/cholangitis/cholangiohepatitis and/or pancreatitis, biopsy is warranted. The decision to pursue endoscopy versus full abdominal exploratory may be impacted by the findings, the relative invasiveness of each procedure and cost. The clinician will need to carefully evaluate what biopsies are needed. Endoscopy limits biopsy of the upper GI tract to the stomach, duodenum, jejunum and proximal ileum (at best). As intramural lymphoma is often found in the ileum, a diagnosis via endoscopy may not be possible. Endoscopy limits the biopsy to primarily mucosal layers and does not provide full thickness biopsy. Lower bowel endoscopy may permit biopsy of the distal ileum via the ileoceccolic junction (ICCJ), but this can be difficult to pass with subsequent difficulties in obtaining quality biopsies. Exploratory surgery permits full visual assessment of all intra abdominal organs, biopsy of extraintestinal tissues (liver, pancreas, lymph nodes etc) and full thickness intestinal biopsy (Kleinschmidt et al, 2010).

References


