

June 4-6, 2023

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June 4-6, 2023

Antimicrobial Stewardship & Small Animal Gastrointestinal Disease: Balancing Patient Outcomes & One Health

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ANTIMICROBIAL STEWARDSHIP & SMALL ANIMAL GASTROINTESTINAL DISEASE: BALANCING PATIENT OUTCOMES & ONE HEALTH

The American Veterinary Medical Association defines antimicrobial stewardship as "actions veterinarians take individually and as a profession to preserve the effectiveness and availability of antimicrobial drugs through conscientious oversight and responsible medical decision-making while safeguarding animal, public, and environmental health."

While antimicrobial use patterns in human medicine have been described in detailed through meta-analyses, smaller scale veterinary studies suggest that antimicrobial prescribing patterns likely approximate those in humans where up to 50% of total use is inappropriate.

Importantly, in the veterinary ER setting, up to 30% of antimicrobials were prescribed for dogs and cats with gastrointestinal (GI) disease, and 45% of all patients prescribed antimicrobials had no evidence of infection. Further, antimicrobials commonly prescribed in these situations (metronidazole, tylosin, amoxicillin clavulanate) have negative impacts in healthy dogs and cats, including dysbiosis, worse fecal scores (i.e. diarrhea), and drug-resistant fecal bacterial populations.

It can be challenging to determine whether antimicrobials are warranted in dogs and cats with GI disease, and often, veterinarians must balance decisions based on underlying etiology, systemic involvement, and impact on patient outcome. Some important scenarios to consider include:

1) Acute gastroenteritis

- 2) Canine acute hemorrhagic diarrhea syndrome
- 3) Idiopathic chronic enteropathies
- 4) Granulomatous colitis

ACUTE GASTROENTERITIS

Acute gastroenteritis in dogs and cats is characterized by GI dysbiosis. These changes are mild and rapidly resolve without intervention. Evidence-based studies evaluating antimicrobial prescription in this condition are primarily limited to dogs. There is no clear benefit for antimicrobial, specifically metronidazole, use in acute canine diarrhea. While one study demonstrated shorter resolution of diarrhea (2.1 days versus 3.6 days) in dogs receiving metronidazole, a larger study demonstrated no difference. Subsequently, a study comparing an easily digestible diet to metronidazole demonstrated 3 days longer time to remission in dogs receiving metronidazole. Several studies have demonstrated increased measures of dysbiosis in dogs with acute gastroenteritis following metronidazole use, which could increase the risk of recurrent disease. Given the combination of these findings, antimicrobial administration is not currently recommended.

CANINE ACUTE HEMORRHAGIC DIARRHEA SYNDROME (AHDS)

This is a syndrome of acute onset hemorrhagic vomiting and diarrhea in dogs, which is associated with GI hyperpermeability, GI bacterial translocation, and bacteremia. Neither the documentation of bacteremia or GI mucosal bacterial involvement impacts patient outcome. Further, when providing appropriate supportive care with intensive intravenous fluid resuscitation, a randomized, placebo-controlled study found no difference in severity of clinical signs, hospitalization time, or survival in non-septic AHDS patients.

However, it is recognized that some dogs present with severe disease and laboratory or clinical concerns for sepsis, including evidence of a consumptive coagulopathy (NB thrombocytopenia is a commonly reported presenting abnormality and alone does not warrant antimicrobial therapy), degenerative left shift,

hypoglycemia, and fever or hypotension that are non-responsive to fluid resuscitation. As no studies have evaluated withholding antimicrobials in this population subset, broad-spectrum antimicrobial (e.g. ampicillin sulbactam) administration is reasonable. Long-term antimicrobial use is not warranted, and therapy can be discontinued once the dog's clinical status stabilizes. There is no utility for initial use or transition to oral metronidazole.

IDIOPATHIC CHRONIC ENTEROPATHIES (CE)

GI microbiome dysbiosis is well-documented in dogs and cats with idiopathic CE. Historically, there has been a subset of dogs described as "antibiotic" responsive, ranging from 11-16% in retrospective studies. However, there are no prospective, controlled studies evaluating antimicrobial efficacy in idiopathic CE dogs or cats and only one small case series that clearly defined antimicrobial responsiveness based on progressive treatment trials and antimicrobial discontinuation. None of these studies has directly compared other microbiome-targeted therapeutics. The current recommendation is to avoid antimicrobials for idiopathic CE dogs and cats given the lack of evidence for use and evidence for antimicrobial-mediated dysbiosis.

GRANULOMATOUS COLITIS

Granulomatous colitis is a CE subset with documented *E. coli* mucosal involvement. It is predominantly recognized as a canine disease, particularly in boxers and French bulldogs, but has been reported in a cat. Because there is relation between disease remission and elimination of mucosal *E. coli*, antimicrobial therapy is warranted. However, it is crucial to obtain a definite diagnosis, including histopathology demonstrating granulomatous inflammation and mucosal invasion by *E. coli* through fluorescence in situ hybridization. Culture is also recommended. These recommendations are due to the need for prolonged fluoroquinolone administration and documentation of fluoroquinolone-resistant *E. coli*.

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June 4-6, 2023

Case Management Rounds: Perioperative Decision Points

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June 4-6, 2023

Feline House Soiling and Marking-"Make it Stop Doc"

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Proceedings for Feline Unacceptable Elimination

Neala Boyer DVM, DABVP (Canine and Feline Practice)

House soiling includes urine marking (spraying), fecal marking (middening) and non-marking (unacceptable toileting). As many of 10% of cats have house soiling over their lifetime. (Borchelt & Voit 1996) The following link is an excellent resource for the practitioner on house soiling: http://journals.sagepub.com/doi/pdf/10.1177/1098612x14539092

Statistics

- House soiling <u>#1</u> reason for shelter relinquishment of a cat (Salman 2000)
- House soiling <u>#1</u> behavioral reason for feline euthanasia once in a shelter (Gorodetsky 1997)

Positive Associations with House Soiling (Mikkola 2023)]

-Fearful cats (also more prone to litter box" fussiness")-Being less social with other cats-Historical (or current) urinary tract disease

A recent study evaluated house soiling in declawed cats without a P3 remnant, declawed cats with a P3 remnant and clawed cats. Declawed cats had a significantly higher odds ratio of house soiling compared to clawed cats. Those with P3 were at a higher odds ratio compared to those without a P3 remnant and a significantly higher odds ratio when compared to clawed cats for house soiling. (Martell-Moran 2018)

Marking (2014 AAFP/ISFM Guidelines)

- Also use litter box
- Advertising (not hidden)
 - » **Sexual**-urine spraying conveys breeding desire
 - » Reactional territorial signaling & socially or environmentally anxious.
- Urine spaying usually standing, sniffing, tail up, treading with back feet with vacant look & backed up against object https://www.youtube.com/watch?v=PiLgus6HpGo
 - Normal or smaller amounts of urine
 - Urine on vertical surfaces usually (can be horizontal)
 - May target new or heat emitting objects, owner's possessions, laundry.
 - Socially significant area
 - Males > females (Pryor 2001)

Can We Impact the Risk of Urine Spraying or Marking?

- Neutering eliminated urine spraying in <u>90% (Tynes 2003)</u>
- Spaying eliminated urine spraying in <u>95% (Hart 2005)</u>
- Age of spay or neuter not related to adult-onset urine spraying.
 - -didn't matter if spay or neuter <24 or >24 weeks of age (Porters 2014)
 - Cleaning urine marks daily, scooping daily & changing litter weekly reduced urine spraying 50% (Pryor 2001)
- Does unacceptable elimination increase in multi cat homes?
 - -Having >1 cat increased marking by 6-fold & 2-fold for unacceptable toileting (Barcelos 2018)
 - A review of 15 papers had mixed results on this subject (Finka 2022)

Unacceptable toileting (non-marking) (2014 AAFP/ISFM Guidelines)

- **discontinuing (at least partially) box use** of urine and/or stool
- urine-squat, normal volume, horizontal surface
- may void next to the box OR hidden area (especially soft substrates)
- male = female

 " dissatisfaction" (investigate without entering box, no digging or covering, perching on box side/avoiding litter contact

Excellent resource for history

http://journals.sagepub.com/doi/suppl/10.1177/1098612X14539092/suppl_file/Cat_owner_questionnaire.pdf The aforementioned will reduce the practitioners time for history collection dramatically leaving the work to the pet owner. The document should be sent to client in advance of a house soiling consultation and includes a diagram of the owner's home with resources, litterboxes, and areas of house soiling. A map of the areas of house soiling may be useful to determine the cause of the problem and if the issue is marking vs. unacceptable toileting.

Physical Examination

A thorough assessment of the cat including neurological, musculoskeletal assessment and checking for penile barbs in male cats in needed. Pain is a common finding in house soiling cats and necessitates appropriate management.

Testing

Perform a minimum database of blood, urine, or stool testing (depending on type of house soiling) along with diagnostic imaging. This information is necessary, as an underlying or inciting medical problem may exist. (Tynes 2003/Simpson 2007) Additionally, this information is used as a baseline for medication when needed for marking.

Environmental Modifications using the 5 Environmental Pillars for House Soiling Management 2014 AAFP/ISFM Guidelines

Safety

Resources

Play and Predation

Human Interaction (as determined by the cat)

Odor Control

Litter box design 2014 AAFP/ISFM Guidelines

**demonstrated benefits for any house soiling cat (marking or unacceptable toileting) **

- Private & well-lit area
- Avoid high human traffic & noisy appliances near box.
- Avoid food or water adjacent to box.
- Provide 360° view + greater than 1 exit (avoid an ambushing cat)
- n + 1=one litter box per cat + 1 (Nielson 2003)
 - < number of cats= increased the risk of FLUTD (Piyarungsri 2020)
- Keep toe hair shorter on long haired cats to avoid clumping onto feet.
- Minimum 1 litter box per level of the home, separated locations (not in a row)
- Replace malodorous boxes.
- Low entry box for kittens, older or arthritic cats
- Black light to identify urine accidents + enzymatic cleaner to disinfect them.
- Block or cover
 - close off area of soiling, use upside down carpet runner, X Mat, double sided sticky tape, foil, pinecones in potting soil, make it a play or feeding area.
 - Study-reconstituted partial volatile fraction of intact adult male cat anal glands (CEMS) applied to one of 2 litter trays vs. control (Kasbaoui 2022)
 - Cats explored & voided stool & urine significantly less in the tray with the CEMS.
- Place in area of inappropriate elimination & inch to desired location starting 2 weeks after consistent use.
- Consider cat preference for covered vs. uncovered box.

- Avoid liners (clawed cats may be adverse)
- Scoop waste 1-2 times daily
- Presence of a wet patch or object looking like feces influenced cats' use of box rather than odor (Ellis 2017)
- At least 3cm litter in box

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- Dump litter & disinfect box with hot, soapy water every 1-4 weeks (prefer every 1 week if house soiling)
 - <u>NO BLEACH (alters olfaction in cats/harsh)</u>
 - <u>NO AMMONIA (harsh)</u>
- For urine spraying place lid behind the box to capture wall marking

Rapid Onset Drugs for Marking or Spraying (no FDA approved)

Not indicated for unacceptable toileting unless a concurrent anxiety issue exists

- Gabapentin inhibiting excitatory neurotransmitters.
 - acute anxiety
 - chronic pain
 - dose reduce with chronic kidney disease in cats (Quimby 2022)
 - Benzodiazepines facilitate GABA (relaxed) activity.
 - reduced marking while taking medication.
 - <u>acute anxiety /situational use</u>
 - NO oral diazepam (hepatotoxicity in cats)
 - duration
 - alprazolam 2-3 hours, lorazepam 4-6 hours, oxazepam & clonazepam up to 10 hours
- **Buspirone** (serotonergic & mildly dopaminergic)
 - About 55% of cats had favorable response with drug discontinued at 2 months (Hart 1993) — up to 1 month to see effect.
 - "Bravery drug" for victim cat (become assertive/friendly & social cat)
 - » ex. learned fear of litter box following obstipation event.
- Progestins (megestrol acetate)
 - **not recommended**
 - only if alternative to euthanasia in neutered male refractory to all strategies
 - » risk of mammary adenocarcinoma, diabetes mellitus, liver toxicity

Long-Acting Drugs for Marking or Spraying (no FDA approved) & 4-6 Weeks to Effect

******Not indicated for unacceptable toileting unless a concurrent anxiety issue exists ****** SSRI

Fluoxetine (Prozac[®]) (Reconcile[®])

- 1 mg/kg PO q 24 hours (Pryor 2001)
 - decreased urine spraying vs. placebo at 8 weeks.
 - » 6 weeks saw 90% reduction.
 - » Adverse effects include GI upset, inappetence, irritability, anxiety, lethargy, decreased grooming, urine & fecal retention.

<u>TCA</u>

Clomipramine (Clomicalm®) Approved for urine spraying in Australia.

- 0.54mg/kg PO q 24 hours without behavioral modification
 - 75% reduction of urine spraying at 4 weeks vs. placebo (Landsberg 2005)
- 0.25-0.5mg/kg q 24 hours PO with behavioral modification
 - 83% reduction in urine spraying at 4 weeks vs. placebo.
 - More lasting effect when used >8 weeks (King 2004)
- Risks
- anticholinergic effects, GI upset, stool & urine retention, pro-arrhythmia (avoid with cardiac disease), depression, increased intraocular pressure, inappetence, sedation, lowered seizure threshold (avoid with seizures)

Experimental Long-Acting Treatment for Marking Seratonin and noradrenaline Receptor inhibitor (SSNRI)

Venlafaxine (Effexor)

- Study-11 treated cats at 1mg/kg q 24 hours + 10 placebo cats with fear reactions, aggressive behaviors & house soiling (Metz 2022)
 - Consultations day 0, 30 and 60
 - Adverse effect (drowsiness)
 - Results
 - Did not improve cats' compliance in carrier removal or handling at veterinarian.
 - Easy to administer.
 - Venlafaxine + behavior modification reduced fear & aggression at 30 days & house soiling at 60 days vs. placebo + behavior modification.

Take away-more studies needed to establish safe dose, efficacy & use indications as sample size is too small to justify routine use

Client Instructions for Care

This link is a fillable PDF with quick fillable recommendation for home care to reduce the practitioners' time making these recommendations.

https://journals.sagepub.com/doi/suppl/10.1177/1098612X14539092/suppl_file/Take_home_instructions_for_cat_owners.pdf

Client Resources

http://foodpuzzlesforcats.com https://www.adventurecats.org/ www.cdpets.com https://www.purrfectfence.com/products/100-free-standing-cat-enclosure-system https://www.zeroodor.com/collections/all www.icatcare.org/vets/guidelines https://indoorpet.osu.edu/cats

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June 4-6, 2023

When Separation Leads to Anxiety in our Companions

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Proceedings for Separation Anxiety

Neala Boyer DVM, DABVP (Canine and Feline Practice)

Both dogs and cats may experience separation anxiety or separation-related distress when separated either physically or visually from a particular caregiver. This experience can either be physiologic (and easily missed) or profound. Symptoms may include vocalization, destruction (often near the owner's exit point, inappropriate elimination in a house-trained pet, hypersalivation, panting, attempts to escape, repetitive behaviors, self-mutilation, and autonomic signs. In cats, inappropriate urination is frequently seen, leaving many owners believing the cat is trying to "get back" at the owner or family member for leaving.

Numerous studies (with varying results) have attempting to characterize why or who will develop separation anxiety. Through inconsistent results, some consistencies are a genetic basis (Van ruey 2006), pain as a comorbid condition (musculoskeletal, atopic, gastrointestinal) (McAuliffe 2022), triggered by a schedule change or traumatic event (Flanigan 2001), lack of social or environmental exposure between 5-10 months of age (Sherman 2008), and lack of obedience classes (Flannigan 2001). A recent study demonstrated (contrary to what was previously accepted) many dogs with separation-related distress appear to have insecure relationships with their primary caregiver which is thought to contribute to the development of distress (Konak 2019). Owners who have insecure or avoidant interactions with their dog may deprive useful signaling used by the dog to modify its behavior. When this contextual information to alter behavior is absent it may contribute to anxiety (Meneses 2021).

Historically many believed pets with separation anxiety "loved" their pet owner so much they developed separation anxiety in their absence. Additionally, it was though that pet owners somehow contributed to the development by "spoiling" the pet. Excitement and playful tactics including high arousal at arrival and departure did not contribute to the development of separation related distress in treated dogs (Teixeira 2021). Another study failed to demonstrate owner hyper attachment was causal for separation anxiety (Ogata 2016). Children with insecure/anxious caregiver relationships (especially with their mother) have been demonstrated to be at a higher risk for development of separation anxiety (Dallaire 2005) and it has been considered this may reflect what occurs in many of the dogs we see with this condition. Behavioral tests of separation anxiety dogs demonstrated they did not display more affection (proximity and body contact with the owner, eye contact, relaxed tail wagging) toward their owner. (Konok 2011)

While empathizing with these caregivers we must educate that the pet's behaviors are not some sort of retaliation, rather a mental health condition and therefore should be managed as any health condition which necessitates investigation and treatment. Some patients must be treated in an emergent fashion to address self-harm, or owner safety risk if aggression is associated with the separation anxiety. In certain situations, involving a mental health professional may have value to ensure the pet owner has support for the anguish or frustration and potential social isolation they may be experiencing.

Investigation must ensue to determine if separation is the sole cause of the distress vs. another problem such as predatory aggression to an outdoor trigger, cognitive aging change, pain, or another medical condition. In the digital age, nearly everyone has access to record audio and video such as a cell phone, nanny/pet camera, or a laptop/cell phone communication to allow video and audio to be evaluated by the veterinary team. This allows us to witness signs of separation-related distress allowing us to determine the tests needed to ensure we have a baseline for medication (if deemed necessary) or evaluate for other frequency concurrent or existing conditions including noise phobia (Overall 2001). The following link is a short useful separation anxiety screening form which can be used in your practice. https://flvetbehavior.com/wp-content/uploads/2021/05/sep_anx_rdvm_guestionnaire.pdf

Desensitization, counterconditioning, and independence training along with environmental modification have remained mainstays for management. It is commonplace for dogs with this condition to be properly crate trained or not adverse to being in a crate when their caregiver is nearby and seen. It is, however, quite common for these same dogs to panic and experience phobic behaviors when they cannot get to (or visualize) their caregiver. These dogs may experience damage to their dentition and claws from attempt to escape crate enclosure. Many owners erroneously believe they must research and purchase various styles of crates to better contain these dogs which leads to frustration for all. Generally, our goal is to find other ways to house these dogs as an alternative to crating, which may include daycare, pet sitting services, or baby gated areas, or alternative areas in the home with a play or activity pen.

As we examine the pet's environment, we encourage toy rotation and puzzle feeding toys which may be beneficial for dogs and cats alike. Pet may experience "trigger stacking" or develop increasingly phobic behavior as a week goes on if departures are prolonged beyond normal vs. a weekend when a pet owner may be home a greater percentage of the time. We sometimes see pets who necessitate higher doses of behavioral modifying medication(s) as the days of a week go on, or if the owner has an unexpected delay in getting home from what was anticipated by the pet.

We have found that for many pets, creating a sanctuary space and mat training dogs with separation-related distress may be beneficial along with use of the Treat n' Train remote training device.

(<u>https://www.youtube.com/watch?v=HEtNKbDpxIs</u>). An interesting and perhaps helpful tool (based on a study with 1 dog (Mundell 2020)) called Companion may

reduce separation anxiety in dogs though the use artificial intelligence. This trainer allows the caregiver to not only monitor the dog but interacts with the dog including playing games and rewarding with food for performing specific behaviors (https://joincompanion.com). Mental enrichment may be beneficial though use of this tool but should additionally include "sniff walks" or games of "find it" as we work to encourage pet independence. Another tool which may be worth consideration (especially in those who experience concurrent noise phobia) is the **myNoise app** which has adjustable "brown noise" "white noise" "pink noise" to reduce other noise frequencies which may be problematic for a pet with separation and noise phobia to use in their environment to train "calm".

Triggers or cues should be identified which are associated with caregiver departure and to which the pet is negatively responding by demonstrating increased stress in association. The pet owner should be trained to dissociate these cues from departure. By training the pet to no longer associate these with departure, the owner can be asked to practice picking up these objects (keys, bag, shoes) and no longer departing. This practice should be limited to 2-4x daily until no longer triggering the pet's stress. Counterconditioning or pairing something the pet highly values in association with departure cues may be needed in some. Special puzzle toys including frozen treats to diminish anxiety but must be offered at other times to avoid becoming a departure cue.

Practicing graduated departures which are only a few seconds to 1-2 minutes in duration while the pet is being monitored for signs of anxiety can begin the process to condition the pet to more lengthy departures (several minutes), but not all pets are ready to engage in this sort of training without the use of a pharmacologic measure. Learning a new response to a behavior which causes stress or phobia can be challenging for some pets. We must educate these owners learning calm and relaxed behavior while alone is challenging and impossible for some pets without the aid of medication. When practicing graduated or short departures, a departure signal is used to indicate to the pet the departure is of short duration. Signals may include a room spray, placing a specific object in view, etc. Special treats/toys can be used for the departure. To avoid these special treats/toys from becoming a departure cue or trigger for increased anxiety, they should be used intermittently and not only in association with a departure. A real departure is of longer and has the same steps minus the graduated departure signal.

There are several situational use pharmacologic therapies which may be used for separation anxiety, yet none are FDA approved. This, however, should not deter a practitioner from using them to help diminish moderate to severe stress and help the pet to learn a new response to the caregiver's departure. It should be recognized; however, any behavior-modifying medication may not have the desired or expected response. This is especially true of benzodiazepines which

may contribute to disinhibition and are particularly concerning if used in animals with prior aggression. Hyperexcitability can be seen in both dogs and cats with this category. It is optimal to have owners try any medication when they can be present initially to supervise the pet and ensure an undesirable response is not witnessed. While many veterinarians are familiar with gabapentin and trazodone, fewer may use clonidine in phobic dogs. This drug has some interesting literature published to substantiate its use; especially if the dog has failed to have anxiety and fear reduction with other short-acting drugs (Ogata 2011).

Clomipramine[®] and Reconcile[®] are two long-acting FDA approved anxiolytics approved for use in dogs with separation anxiety. Both have been shown to have benefit in management over placebo when combined with behavioral modification. (Radosta 2018), (Overall 2001), Crowell (2003) There is inherent risk of serotonin syndrome when combining trazodone with either of these medications, but this management strategy is frequently utilized. A paper evaluating 56 dogs taking one of the long-acting anxiolytics were additionally dosed with trazodone and after 6+ months of treatment, none of the dogs experienced serotonin syndrome (Gruen 2008). As the long-acting anxiolytics take 4-8 weeks to achieve full effect, short acting anxiolytics will be necessary in pets requiring medication to initiate the process of desensitization and counterconditioning. Some owners of pets with separation anxiety are at risk of eviction, permanent breach of the human animal bond, pet relinquishment or euthanasia if results cannot be achieved faster than 1-2 months required for the long-acting medications to have effect.

Acepromazine is still frequently utilized as the sole therapy for pets with anxiety by some veterinarians. This drug acts as a tranquilizer with no anxiolytic property. As noise phobia is a comorbid condition in numerous dogs with separation distress, this drug (which can enhance noise sensitivity) is an inappropriate choice when used as a sole therapy. Use of acepromazine is acceptable when combined with an anxiolytic for pets requiring tranquilization.

Pet owners who have utilized an anxiolytic drug for themselves are generally more accepting of these medications for their pet (Haaften 2020). It is, however, not uncommon for owners to be resistant to using a behavior-modifying medication for their pet. As professionals, we have a responsibility to our patients to convey the impact of this phobia upon the pet's quality of life and their ability to relax and learn a new response and appropriate response to separation. For those times we have owners resistant to medication (or as an adjunct to medication) we have options which have studies on their efficacy. While not at the same level of peer reviewed respect as the long-acting medications, these therapies may be considered as no significant negative implications have been noted. These include Purina ProPlan Calming Care

https://cdn.brief.vet/webinars/Purina/Webinar+1/Calming+Care+abstract.pdf

and the Calmer Canine tool using targeted pulsed electromagnetic therapy https://assisianimalhealth.com/calmer-canine/

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8720769/pdf/fvets-08-775092.pdf

Telemedicine consultation-our practice routinely uses the services of Dr. Lisa Radosta for clients that are unable or unwilling to travel for a behavioral consultation.

https://flvetbehavior.com/vets/telemedicine-consultations/

Find a behaviorist for in-person evaluation: https://www.dacvb.org

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Owner Handouts

- https://veterinarypartner.vin.com/default.aspx?pid=19239&id=9673053
- https://veterinarypartner.vin.com/default.aspx?pid=19239&id=4952744
- https://veterinarypartner.vin.com/default.aspx?pid=19239&id=4951974
- <u>https://www.aspca.org/pet-care/dog-care/common-dog-behavior-issues/separation-anxiety</u>

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June 4-6, 2023

Optimizing our use of antibiotics and stewardship in small animal medicine

Kate KuKanich, DVM, PhD, DACVIM (SAIM), Kansas State University



Optimizing Our Use of Antibiotics and Stewardship in Small Animal Medicine Kate KuKanich, DVM, PhD, DACVIM (SAIM) Kansas State University College of Veterinary Medicine

Behavioral influences really do affect clinicians' prescribing of antimicrobials

- These include: client expectations, peer pressure, the feeling that "we need to do something," fear of clinical failure, time of day
- These can have more impact on prescribing than evidence-based medical knowledge
- Study found that 24/25 pet owners trust their vet if the vet says the pet does NOT need antibiotics
 - Redding LE & Cole SD, JAVMA, 2019;254:626-635

Example of overprescribing antibiotics in veterinary medicine

- Banfield study showed of 19,153 cats who received antibiotics for lower urinary tract signs, only 372 cats (1.9%) had a confirmed UTI.
 - <u>https://www.banfield.com/Banfield/media/contenthub/files/2018_VET_Report.</u>
 <u>pdf</u>
- Most cats with clinical signs of lower urinary tract disease do <u>not</u> have a urinary tract infection and do not need antibiotics. Best to perform cystocentesis for urinalysis and culture if concerned, but only prescribe antibiotics if culture confirms infection.
 - Urine sediment often misleading, especially when collected by from litter box or tabletop; pyuria occurs with sterile cystitis; bacteria can be contamination
- Cats at higher risk for UTI are those >10years old and those with endocrinopathies or chronic kidney disease.

AVMA Core Stewardship Principles

https://www.avma.org/KB/Resources/Reports/Documents/TFASCAP_Report.pdf

- Commit to stewardship
- Prevent common diseases (vaccines, husbandry, nutrition, etc.)
- Select and use antimicrobials judiciously
 - First determine a diagnosis, and then consider the best treatment
 - Pet owners might be more receptive to diagnostic testing than we expect
 - Ask them and make a good case for why the test would be helpful!
 - Nasal biopsies, tracheal washes, rectal scrapes, liver and GI biopsies can all be really helpful in determining a diagnosis
 - "I solemnly swear that if I do an explore on a vomiting dog and I cannot find a foreign body or cause of the vomiting, I will always take biopsies"
 - \odot

- Treatment solutions
 - \circ Remove the source of infection
 - Lance abscesses, remove foreign bodies (grass awn, orthopedic implant, urolith)
 - Target therapy based on all known information

| Microbe | Gram | pН | shape |
|--------------|----------------|---------------|-------|
| E. coli | | acidic | rods |
| Klebsiella | ŧ | acidic | rods |
| Proteus | - | alkaline* | rods |
| Staph | + | alkaline* | cocci |
| Strep | + | acidic | cocci |
| Enterococcus | ÷ | acidic | cocci |
| * Urease pro | oducers have a | Ikaline urine | |

- Ciprofloxacin?
 - Fluoroquinolones are not 1st tier for canine or feline UTIs but they are needed on occasion. Ciprofloxacin is much cheaper than enrofloxacin but is variably absorbed (30-80%) from the GI tract in dogs, and thus we cannot have confidence that it will be absorbed and do its job. Avoid ciprofloxacin; instead use fluoroquinolones approved for use in dogs and cats. (Papich MG. JAVMA 2012;73:1085-1091.)
- Empirical choices for canine *E. coli* UTIs?
 - Consensus suggests amoxicillin or TMS (caution, TMS side effects)
 - Weese et al. Vet J 2019;247:8-25.
 - In Kansas: 92% susc to Clavamox, 86% susc to cephalexin, 53% susc to amoxi
 - KuKanich K, et al. JVIM 2020;34:227-231.
 - For non-E. coli UTIs?
 - Remember enterococci will not respond to cephalexins or TMS
 - Remember that *Staph* are typically resistant to amoxi but often susceptible to amoxi-clav and cephalexins
- Watchful Waiting/Delayed Prescribing- writing a prescription for antibiotic but dating for the future; helpful in human healthcare; most never get filled because virus resolves on their own with supportive care



 Non-antibiotic prescriptions (right)looks like a prescription but provides suggestions for supportive

care instead; increases client satisfaction without unnecceary antibiotics

- Available online or from KDHE
- https://public.kfmc.org/sites/hai/SitePages/Resources.aspx

- De-escalating- discontinuing antibiotics once culture results are available if no longer needed
- Evaluate antimicrobial drug use practices
 - Banfield study found that 51% of nonrecurrent feline UTIs were being treated with cefovecin (3rd generation cephalosporin)
 - First tier treatments for UTIs should be amoxicillin, amoxi-clav, or cephalexin (not 3rd generation cephalosporins)
 - What do we prescribe in our practices? How often do we do UA and culture before prescribing for a feline UTI or other infection? Are we choosing logical antibiotics? Should we consider keeping track for a month and then discussing any changes in our protocols?
 - University of Minnesota has great antibiotic use tracking tools!
 - <u>https://arsi.umn.edu/tracking</u>
 - Use of Compounded Medications?
 - Use a trusted pharmacist who starts with an FDA approved drug and makes a compounded medication specifically for your individual patient; document reason for compounding; inform client that medication is compounded and limitations of altering the medication
 - Limited list of drugs allowed to be compounded from bulk substance
 - Includes: cisapride, potassium bromide, metronidazole solution
 - <u>https://www.fda.gov/animal-veterinary/animal-drug-</u> <u>compounding/list-bulk-drug-substances-compounding-office-</u> <u>stock-drugs-use-nonfood-producing-animals</u>
 - Other "compounded drugs" sold in bulk to your clinic are not approved, and you should inform your clients about unpredictable quality control, potency, stability, purity, sterility, safety, bioavailability, and efficacy (doxycycline example)
 - With compounded antibiotics, inaccurate potency and stability can lead to subtherapeutic dosing, survival and thriving of resistant bacteria, and ineffective treatment of infections
 - KuKanich K, et al. Evaluation of potency for compounded and FDA approved formulations of doxycycline on receipt and after 21 days of storage. JAVMA 2017;251:835-842.
 - Contaminated compounded methylprednisolone sickens 753 and kills 64 people with fungal meningitis. <u>https://www.fda.gov/inspections-compliance-enforcement-andcriminal-investigations/press-releases/january-31-2018-newengland-compounding-center-pharmacist-sentenced-rolenationwide-fungal
 </u>

- Educational Resources
 - AVMA has great resources available (articles, guidelines etc.) as well as posters for in hospital to help provide guidance for veterinary staff on responsible use and to help clients learn about when antibiotics are indicated
 - <u>https://www.avma.org/resources-tools/one-health/antimicrobial-use-and-antimicrobial-resistance/antimicrobial-use-veterinary-practice</u>
 - KSU Veterinary Health Center fliers for carbapenem-resistant organisms; provides guidance for veterinary staff and for clients on what to do if a resistant organism (carbapenem-resistant Enterobacterales, carbapenem-resistant *Pseudomonas*, or methicillin-resistant *Staph*) is isolated from one of our patients/pets
 - https://www.ksvhc.org/clients/ARB/

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June 4-6, 2023

What's new with managing companion animal respiratory infections?

Kate KuKanich, DVM, PhD, DACVIM (SAIM), Kansas State University



What's New with Managing Companion Animal Respiratory Infections? Kate KuKanich, DVM, PhD, DACVIM (SAIM) Kansas State University College of Veterinary Medicine

Cats with Upper Respiratory Infections

- Most cats have viral disease and don't need diagnostic workup
 - Consider diagnostic testing if unusual presentation, recurrent/nonresponsive to supportive care, worsening despite treatment
 - Tests to consider: oral and otoscopic exam, cryptococcus capsular antigen, CT, nasal biopsies for histopathology, bacterial/mycoplasma culture/PCR
 - Nasal Biopsies in the Cat
 - Use rigid alligator forceps or flexible endoscopy biopsy tool
 - Measure to medial canthus of eye, and do not go any further in than measurement
 - Collect biopsies from suspected area of lesion or from all areas of both nasal cavities if diffuse; 5-10 biopsies per side; there will be minor bleeding from biopsy sites; put biopsied tissue into cassette to keep safe during transit, then cassette into formalin.
 - Can put 1-2 biopsied tissue samples into culturette, red-top tube, or E-swab for bacterial culture and *Mycoplasma* testing (consult with lab)
- Suggested Therapy Guidelines
 - If clear nasal discharge, think viral and treat supportively (no antibiotics)
 - If purulent nasal discharge but no fever, eating well, not lethargic, it's probably still viral, treat supportively, (prescribe antibiotics only if not improving after observation period of 7-10 days)
 - If nasal discharge and febrile, anorexic, and/or lethargic consider starting antibiotics sooner
 - Doxycycline 5mg/kg PO BID is good first choice for treatment
 - Use liquid doxycycline because capsules and tablets can cause esophageal strictures in cats and other species!!!
 - Compounded doxycycline has variable potency (content), can lead to treatment failure and should be avoided (see figure below).



Mycoplasma

- Can be normal flora or cause illness in canine and feline respiratory tracts
- Do NOT have a cell wall, so we cannot use beta lactams to kill them
- Treatment options: doxycycline, azithromycin, fluoroquinolones, TMS, chloramphenicol

Amoxicillin and Amoxi-clav

- Amoxicillin- good for some resp infections (Pasteurella, Strep, Enterococcus, anaerobes)
- Amoxicillin-clav has added coverage for *Bordetella* and some beta-lactamase producers

Azithromycin

- Good coverage for *Mycoplasma* and many respiratory infections; well tolerated as liquid or pills
- Challenge #1: it is not listed on many culture/susceptibility panels....use erythromycin as the class representative (if susceptible to erythromycin, should be susceptible to azithromycin too)
- Challenge #2: we really don't know how to best dose it in dogs and cats!!! Lots of protocols available in formularies, no consensus among veterinary pharmacologists

Nonantibiotic Prescription helpful to offer supportive care for cats with suspected viral rhinitis

• Available online or from KDHE; <u>https://public.kfmc.org/sites/hai/SitePages/Resources.aspx</u>

| Rx | Date |
|----|------|

The clinical signs your cat presented with today suggest a respiratory virus caused by herpesvirus or calicivirus.

Your cat has NOT been prescribed antibiotics because antibiotics are not effective in treating viral infections and can cause adverse effects such as inappetence, vomiting and diarrhea.

These viruses run their course over 7-10 days without specific therapy.

Your great nursing care at home can help!

- Keep your cat's nose clean using a soft wet washcloth or cotton ball as needed.
- Use a humidifier with water (no medication) in the room where your cat sleeps.
- Offer canned food that is warmed to increase its aroma and tempt your cat's appetite (be sure it's not too hot!)

Over-the-Counter Medication:

· L-Lysine 250-500mg by mouth every 12 hours with food might be helpful for some cats with herpesvirus

Additional Tips:

- Try to minimize stress for your cat during his/her recovery.
- Keep isolated from new cats to minimize spread of disease.
- Please call or bring your cat back in for recheck if clinical signs do not improve in _____ days or worsen at any time.



Dogs with Kennel Cough

- Not all need antibiotics!
- Strep zooepidemicus
 - Kennel cough rapidly progresses into hemorrhagic pneumonia (coughing up blood)
 - Very contagious
 - High mortality, treat ASAP
- Sick Kennel Cough Dogs
 - Take radiographs- Is there pneumonia? Where is the pneumonia?
 - If pneumonia, consider



- tracheal wash to collect fluid for cytology and culture
 - What bug is there and how can we best treat it?
- Endotracheal washes can be performed on any size dog or cat. Endotracheal washes carry risk of general anesthesia and results must be interpreted in light of possible oropharyngeal contamination. First pre-oxygenate, then induce the patient (often propofol) and intubate them with a sterile (autoclaved) endotracheal tube. Wear sterile gloves, use clean laryngoscope, and don't touch the oral cavity with the tube). For small dogs or cats, a blue "Christmas tree adaptor" can be attached directly to the endotracheal tube so that you can attach a syringe with sterile saline directly to your endotracheal tube. For larger patients, a red rubber catheter can be inserted through the endotracheal tube for the saline wash. I flush 5-10ml sterile saline for small dogs/cats, and 10-20ml for larger dogs. The fluid should be rapidly pushed into the tube, the patient should be coupaged, and suction back on your syringe immediately to aspirate and retrieve as much fluid as possible. A successful tracheal wash in a patient with pneumonia will produce purulent fluid. We expect to collect about 30% of the fluid that is inserted; the rest is absorbed. The procedure can be repeated if needed and if the patient is stable. The patient is then allowed to wake up and provided oxygen on recovery. The entire procedure takes <5 minutes. The fluid is then submitted to diagnostic lab in purple top for cytology (fluid analysis) and red top or E-swab for aerobic (+/-anaerobic culture).
- Transtracheal washes are good for medium and large dogs that can be adequately restrained for this awake procedure. Benefits of transtracheal washes are that 1) the dog is the awake, 2) the dog is able to cough, therefore there is greater likelihood of collecting fluid from the lower airways and alveoli, and 3) there is no oropharyngeal contamination. Transtracheal wash is contraindicated in cases with coagulopathies or severe skin disease around the neck. A transtracheal wash is performed with a local lidocaine block on a shaved and surgically prepped area of the neck, with the dog in sternal recumbency or sitting position. A through-the-needle long IV catheter is inserted just distal to the larynx between 2 tracheal rings. Once the catheter is fully inserted into the trachea, the needle is backed out of the neck and protected with the plastic cover, and the stylet is removed. A syringe with sterile saline (5-10ml for small dogs, 10-20ml for larger dogs) is then attached and flushed into the catheter, and rapidly aspirated to remove fluid; this can be repeated if needed, and can be done as the catheter is slowly withdrawn

from the trachea. The patient should be coupaged and encouraged to cough as the saline is infused. Once the procedure is completed, the catheter is removed, and the patient is given oxygen supplementation during recovery. A light bandage can be placed around the insertion site on the trachea. Submit cytology (purple top) and culture (red top or E-swab).

- Treating Bacterial Pneumonia- while waiting for culture...
 - If suspect *Bordetella* or *Mycoplasma*, start with doxycycline
 - If suspect *Strep zooepidemicus*, start with ampicillin or amp-sulbactam
 - If rads show <u>bronchopneumonia- remember there is a blood bronchial barrier that</u> prevents beta lactams from achieving therpeutic concentrations in the bronchi. Use fluoroquinolones, azithromycin, doxy, or ceftiofur, or high dose of beta lactam (ampicillin 30mg/kg IV TID).
 - If interstitial pneumonia without bronchial component, okay to use beta-lactam alone or some will do ampicillin/enro until culture is back
 - If concerned about anaerobes (lung abscess?)- consider clindamycin (only liquid in cats)
 - If myasthenia gravis and megaesophagus causing aspiration pneumonia, avoid fluoroquinolones, as FQs can exacerbate MG; consider ceftiofur in these dogs as injectable might be a better option to bypass the esophagus and most owners can administer once daily at home
 - Avoid cough suppressants in kennel cough dogs who have pneumonia; we want them to cough up the infectious phlegm rather than trap it in their lungs

De-escalate- when culture results are available, discontinue any unnecessary antibiotics

IV to Oral medications- try to stay in same family (drug class)

How long to treat bacterial pneumonia?

• No evidence-based rule. consider 10-14 days, then recheck rads, might need longer.

References:

- KuKanich K, KuKanich B, Slead T, Warner M. Evaluation of drug content (potency) for compounded and FDA-approved formulations of doxycycline on receipt and after 21 days of storage. JAVMA 2017;251:835-842.
- Lappin MR, Blondeau J, Boothe D, et al. Antimicrobial use Guidelines for treatment of respiratory tract disease in dogs and cats: Antimicrobial Guidelines Working Group of the International Society for Companion Animal Infectious Diseases. JVIM 2017;31:279-294.
- Wayne A, et al. Outcomes in dogs with uncomplicated presumptive bacterial pneumonia treated with short or long course antibiotics. Canine Veterinary Journal 2017;58:610–613.

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June 4-6, 2023

Anesthesia in dogs & cats with cardiac disease





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June 4-6, 2023

What's New in Brachycephalic Syndrome - Part 1 & Part 2





BRACHYCEPHALIC AIRWAY SURGERY PAST AND PRESENT Heidi Phillips VMD, DACVS-SA University of Illinois College of Veterinary Medicine, Urbana, Illinois

Key Points:

- Dogs referred for treatment of brachycephalic syndrome including sleep apnea should be evaluated by physical examination, sedated oral examination, CT, and endoscopy
- A combination of innovative endosurgical and surgical treatments may improve outcomes in dogs with brachycephalic syndrome

Brachycephalic syndrome is a chronic, debilitating, and potentially fatal condition of canine breeds with severely shortened craniofacial conformation, including the Pug, French bulldog, English bulldog, Japanese chin, Boston terrier, Pekingese, Shih tzu, Cavalier King Charles Spaniel, and other breeds.^{2,5,13} Demand for severe brachycephalic conformation as a breed standard persists despite the known encumbrances imposed upon the brachycephalic animal.¹ The American Kennel Club and Kennel Club of the United Kingdom reported increases in registration of brachycephalic breeds over 450% from 2000-2010, creating a sizable population of dogs at risk.^{1,9,10,13}

Congenital and acquired deformities result from selection for craniofacial bony shortening without a concomitant reduction in the volume of nasopharyngeal and oropharyngeal soft tissues. ^{9,11-13,16,17} Clinical signs associated with the respiratory tract predominate in affected dogs. Respiratory clinical signs range from mild to severe and include snoring or stertor, coughing, stridor, inspiratory dyspnea, difficulty eating, exercise intolerance, cyanosis, collapse, syncope, and death.^{3,13,16,17} Acute signs can be exacerbated by obesity or stressful situations such as overheating, excitement, and exercise.^{3,17} Primary respiratory abnormalities include stenotic nares, elongated soft palate, and hypoplastic trachea, diagnosed in 58-85%, 62-100%, and 13% of brachycephalic dogs, respectively.^{3,6,10} Recently, aberrant rostral and caudal nasopharyngeal turbinates and intranasal mucosal contact points have been described as primary abnormalities in dogs.^{4,19} These primary anatomic anomalies comprise the moderate to severe fixed upper airway obstruction that plagues most dogs with brachycephalic syndrome.²

Despite the foreshortened nose being the most prominent feature of brachycephaly, traditional classifications and treatments of brachycephalic syndrome have failed to address the intranasal obstruction.^{4,5,11,12,19} Airflow through the nasal cavities accounts for 76.5% of the total airflow resistance in the respiratory tract in normal dogs.^{10,19,20} Poiseuill's law states that a 50% reduction in radius results in a 16-fold increase in flow resistance. Therefore, a decrease in the dimension of the nares, nasal passages, or laryngeal airways increases the upper airway resistance in brachycephalic breeds significantly compared to that of a non-brachycephalic dog. Secondary abnormalities result from chronically increased resistance to airflow, and include enlarged and everted tonsils, everted laryngeal saccules, laryngeal and pharyngeal mucosal edema, and laryngeal collapse.^{2,10,17,19} In recent years, the brachycephalic conformation has also been implicated in gastrointestinal disorders including regurgitation, vomiting, gastritis,

duodenitis, hiatal hernia, and aspiration pneumonia; sleep disorders including sleep apnea; cardiopulmonary disorders including hypoxemia, hypercapnea, bronchial collapse, polycythemia, heat stroke, and hypertension; and neoplastic disorders such as chemodectoma.^{3,5,6,13,15-17} Additionally, sleep apnea may be linked to the development of systemic hypertension in brachycephalic dogs, as in people.^{6,13} Brachycephalic dogs require mechanical ventilation more often than non-brachycephalic dogs and were most frequently ventilated in one study for respiratory fatigue secondary to aspiration pneumonia.⁷ Finally, acquired myocardial damage may also be present in brachycephalic dogs- cardiac troponin-1 levels were elevated in 48% of dogs in one report.^{10,14}

Given the grave implications of chronic upper airway obstruction, surgery is indicated to correct primary abnormalities early in life to improve quality of life and prevent development of secondary changes.^{5,10,17,21} However, traditionally employed surgical procedures such as wedge resection of the ala nasi (alar wings) and staphylectomy (shortening of the soft palate) do not address the intranasal components of the fixed obstruction and therefore fail to prevent secondary changes and progression of clinical signs in many dogs.^{2,5,11,12,17,19}

Recent reports note the presence of nasopharyngeal turbinates and intranasal mucosal contact points in 72% and 87% of brachycephalic dogs examined, respectively.^{11,19} A novel endosurgical procedure, laser-assisted turbinectomy (LATE), was introduced recently by Gerhard Oechtering and shown to result in decreased mucosal contact points in the nasal passages and improved nasal patency.^{12,20} However, this promising procedure is currently performed at only one institution worldwide (Germany) and has not been objectively evaluated as part of a comprehensive approach to surgical treatment of brachycephalic syndrome. However, Dr. Oechtering has gathered extensive preliminary data from over 150 brachycephalic dogs evaluating the effects of the LATE procedure on nasal patency as assessed by computed tomography (CT) and endoscopy. Six months post-operatively, CT examination revealed patent nasal airways in 84% of dogs. Computed tomography and endoscopy revealed conchal or turbinate regrowth sufficient to require repeated resection in only 16% of dogs.²⁰ To evaluate the effect of LATE on nasal airway resistance, Dr. Oechtering performed impulse oscillometry on 25 dogs with severe symptoms of brachycephalic syndrome. A decrease in *nasal* airway resistance of 55% was documented from measurements taken preoperative to those taken 3-6 months postoperative.

Use of a multilevel surgical treatment that includes the LATE procedure as well as refinements of traditional surgical treatments have the potential to improve outcomes in dogs with brachycephalic syndrome. Multilevel surgical treatment of brachycephaly addresses all treatable primary areas of upper airway obstruction including the deformed ala nasi and vestibulum nasi, aberrant nasopharyngeal turbinates, and elongated soft palate, as well as secondary areas of obstruction including everted tonsils and everted laryngeal saccules.^{12,20} Development of the LATE procedure and refinement of traditional upper airway corrective procedures represent the only major advances in the treatment of brachycephalic syndrome in decades.¹⁹ As ownership of brachycephalic breeds has skyrocketed worldwide in recent years, *objective assessment* of the effects of the proposed procedures on upper airway resistance is

critically needed to evaluate efficacy and completeness of clinical improvement.^{1,2,9,10,13,16} Validation of multilevel surgical approaches to treatment of brachycephalic dogs through clinical trials and clinical reports would permit recommendation of the technique and its widespread adoption.

Anesthesia:

Metoclopramide or cisapride along with maropitant and an H2 antagonist or proton pump inhibitor should be administered prior to induction of anesthesia to prevent the occurrence or minimize the effects of regurgitation and aspiration pneumonia during procedures. A typical induction protocol includes an opioid medication such as butorphanol and propofol or alfaxalone. Prior to intubation, all dogs should be assessed by oronasal examination for the presence and extent of deformity of the ala nasi and vestibulum nasi, elongation of the soft palate, and eversion of tonsils and laryngeal saccules. Dogs should then be intubated and maintained with 1-4% isoflurane in oxygen. Dogs may be temporarily extubated during CT and later during endoscopy of the oro-, naso-, and laryngopharynx, and may require further propofol or alfaxalone administration during the period of extubation. Dogs should be positioned for CT and endoscopy in sternal recumbency with the maxilla supported by a fixation device behind the canine teeth to keep the hard palate parallel to the CT table and the orotracheal area wide open. Dogs should undergo ECG, pulse oximetry, end-tidal carbon dioxide, and indirect blood pressure monitoring, and assessment of anesthetic depth, heart rate, respiratory rate, and temperature every 5 minutes. Lactated Ringer's solution or another balanced ionic fluid should be administered at 5-10 ml/kg/h during the anesthetic period.

Diagnostic Imaging:

Diagnostic imaging screening of dogs should include head, neck, and thoracic CT evaluation under general anesthesia. Computed tomographic scans should be performed with a 16-128 slice spiral CT scanner.^a Using an appropriate bone algorithm and settings, slice thicknesses of 1.0 mm and 0.5-0.6 mm should be obtained. Images acquired in the transverse plane should be used for planar reformations of the dorsal and sagittal planes. Images of the nasal cavity should be examined by board certified radiologists and for septal deviation and abnormal conchal or turbinate growth as previously described.^{11,19}

Endoscopy and Laser-assisted Turbinectomy (LATE):

Anterior rhinoscopic examinations should be performed using a 2.7 mm 0° rigid endoscope^b placed into the nasal vestibulum to obtain a 5-fold-view of the nasal folds including the plica recta, plica alaris, plica basalis, and ventral and dorsal septal swell bodies.¹⁹ Conchal configuration, mucosal contact points and classification of aberrant turbinates should be assessed as previously described.^{4,11,19} The nasopharyngeal meatus, choanae, and nasopharynx should be examined with posterior rhinoscopy using a 4 mm, 120° endoscope.^b Laser-assisted turbinectomy (LATE) of rostral and caudal aberrant turbinates can be performed using a 2.7 mm 30° rigid endoscope^b and diode laser with 400 µm fiber at a setting of 3-4 watts in a 50/50 pulsed mode as described.¹²

Surgical Procedures:

Ala vestibuloplasty: Using a #11 blade, the ala nasi, or medial aspects of the alar wing, can be resected together with the obstructing vestibulum nasi by deep extension of the #11 blade to remove a longitudinal wedge of tissue.^{12,20} Bleeding should be controlled by electrocautery, mild tamponade with cotton swabs, or topical oxymetazoline.

Staphylectomy: A stay-suture of 4-0 absorbable suture, poliglecaprone-25, may be placed at the caudal aspect of the left and right tonsillar crypts. The excessive length of soft palate extending beyond the tip of the epiglottis or caudal aspect of the tonsillar crypts should be excised using Metzenbaum scissors.¹⁶ The nasal and oral mucosa of the soft palate should be apposed using the right stay suture and needle using a simple continuous pattern of 4-0 poliglecaprone-25 over the cut palatal muscle and tied to the tag of the left stay suture. Alternatively, a vessel sealing device may be used.

Everted tonsils and laryngeal saccules: Using a diode laser with 400 μ m fiber at a setting of 3-4 watts in a 50/50 pulsed mode and operating microscope at 20x magnification, microlaryngoscopic laser ablation of everted saccules and microscopic laser ablation of everted tonsils can be performed.¹² Excision can also be sharply performed with scissors.

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Footnotes:

^aGE Lightspeed® Computed Tomographic Scanner, General Electric, Boston, MA ^bKarl Storz Veterinary Endoscopy North America, Goleta, CA ^cSPIES system, Karl Storz Veterinary Endoscopy North America, Goleta, CA

Managing Brachycephalic Patients in Your Practice Heidi Phillips VMD, DACVS-SA Associate Professor Small Animal Surgery University of Illinois

- I. Brachycephalic Obstructive Airway Syndrome is a condition resulting from a constellation of physical abnormalities that combine to cause upper airway obstruction in patients.
- II. Poiseuille's Law
 - a. Flow through an area is proportional to the radius to the 4th power
- III. Predisposed breeds
 - a. Dogs: English Bulldog, Pug, Pekingese, Shih Tzu, Lhasa Apso, Boxer, Boston Terrier, Cavalier King Charles Spaniel
 - b. Cats: Persian and Himalayan
 - c. Young, middle aged, or older animals
 - d. No sex predilection
- IV. Diagnosis
 - a. Physical examination findings
 - i. Primary abnormalities
 - 1. Stenotic nares
 - 2. Elongated soft palate
 - 3. Hypoplastic trachea
 - 4. Nasopharyngeal turbinates
 - ii. Secondary abnormalities
 - 1. Laryngeal collapse
 - a. Stage I: Everted laryngeal saccules
 - b. Stage II: Cuneiform process collapse
 - c. Stage III: Corniculate process collapse
 - 2. Pharyngeal edema
 - 3. Everted tonsils
 - b. Clinical signs
 - i. Respiratory
 - 1. Many dogs experience noisy breathing as the only notable clinical sign. Snoring while sleeping is most commonly seen.
 - 2. Stridor is upper airway noise due to obstruction of the oropharynx or common pharynx
 - 3. Stertor is upper airway noise due to obstruction of the nasopharynx
 - 4. Problems during eating or drinking, aspiration pneumonia
 - 5. Syncope, cyanosis, exercise intolerance
 - 6. Worsened by exercise, excitement, heat, or stress
 - ii. Gastrointestinal
 - 1. Often due to increased negative airway pressure causing sliding hiatal hernia
 - 2. Can also see pharyngeal incoordination

- 3. Vomiting, regurgitation
- 4. Dysphagia, aerophagia
- 5. Aspiration
- c. Physical examination
 - i. Avoid stress!
 - ii. Avoid restraint!
 - iii. Be prepared!
 - iv. TPR and mucous membrane color, auscultation
 - v. Respiratory distress
 - 1. Paradoxical respiratory motion
 - 2. Orthopneic posture
 - vi. Stenotic nares
 - vii. Sedated physical examination
 - 1. Elongated soft palate
 - 2. Laryngeal collapse
 - 3. Pharyngeal edema
 - 4. Everted tonsils
 - 5. Nasopharyngeal turbinates
- d. Laboratory and point of care evaluation
 - i. CBC, SBP
 - ii. Pulse oximetry
 - iii. Venous or arterial blood gas evaluation
- e. Radiographic evaluation
 - i. Neck and chest radiographs are indicated to evaluate for other causes of upper airway obstruction and to evaluate for cardiac changes and signs of non-cardiogenic pulmonary edema or hiatal hernia
- f. Rhinoscopy
- V. Treatment
 - a. Medical
 - i. Avoid exercise, excitement, heat, and stress
 - ii. Avoid neck leads!
 - iii. Sedative medications
 - 1. Acepromazine 0.005-0.01 mg/kg IV or IM or 0.25-0.5 mg/kg PO q4-6 h or PRN
 - 2. Butorphanol 0.2-0.4 mg/kg IV, SC, IM, or PO
 - iv. Anti-inflammatory medications
 - 1. Prednisone 0.5-1 mg/kg/d PO
 - 2. Dexamethasone sodium phosphate 0.1-0.2 mg/kg q24h
 - v. Gastrointestinal protectants and antiemetics
 - 1. Famotidine 0.5 mg/kg IV or PO q12-24h
 - 2. Omeprazole 1 mg/kg PO q24h
 - 3. Metoclopramide 0.2-0.4 mg/kg PO or SC q8h ½ hour before feeding
 - 4. Dolesetron 0.6 mg/kg IV or SC q12-24h
 - 5. Sucralfate slurry

- vi. Diet
 - 1. Limiting weight gain and avoiding obesity can lessen intrathoracic and cervical fat accumulation and minimize respiratory compromise.
- b. Surgical
 - i. Timing
 - 1. I currently recommend early intervention for brachycephalic patients, ie treatment of stenotic nares, +/elongated soft palate and everted saccules as early as at the time of ovariohysterectomy or castration or at the earliest sign of clinical effect.
 - 2. Secondary abnormalities may be more likely to develop in patients that do not receive early intervention.
 - ii. Stenotic nares
 - 1. Wedge or crescent resection alaplasty
 - 2. Alapexy
 - 3. Alar amputation
 - iii. Elongated soft palate
 - 1. I prefer to NOT use the CO2 or another laser. LASER therapy does not ensure accurate and stable apposition of the nasal and oral mucosa over the cut edge of the soft palate muscle. Granulation tissue formation can result and lead to dehiscence and worsening upper airway signs.
 - 2. Hand cutting with Metzenbaum scissors and hand suturing
 - 3. Ligasure[®] bipolar vessel sealing device
 - iv. Laryngeal collapse
 - 1. Stage I: resection of laryngeal saccules is absolutely possible without performance of preemptive temporary tracheostomy. Additional hands are needed to provide retraction of an orally placed endotracheal tube, tongue, and epiglottis. The everted saccular tissue is grasped at the tip with Debakey forceps and the tissue is cut near the vocal folds using Metzenbaum scissors or a scalpel blade. Bleeding is generally minimal and is controlled with gentle tamponade by a cotton-tipped applicator.
 - Stage II and III: Unilateral arytenoid lateralization has been utilized in a small number of dogs with success. Alternatively, permanent tracheostomy is utilized, especially in cases with severe pharyngeal dysfunction or signs of megaesophagus.
- VI. Post-operative monitoring
 - a. Owners must always be warned that temporary worsening or respiratory effort is possible
 - b. Despite our best efforts to utilize gentle tissue handling and accurate technique, pharyngeal swelling may worsen following airway surgery. Additionally, anesthesia causes relaxation of pharyngeal musculature,

making maintenance of an open airway difficult in the post-operative patient. Tracheostomy may be required to permit adequate ventilation and oxygenation while pharyngeal edema and swelling resolve over a period of 1-5 days.

- c. Maintaining the endotracheal tube in place for as long as possible upon anesthetic recovery may permit return of pharyngeal tone and maintenance of a patent airway more immediately upon extubation.
- d. Provide flow-by oxygen support or utilize an oxygen cage set at 40% inspired oxygen
- e. Thermoregulation
 - i. Do not allow the patient to become overheated
 - ii. Maintain them in a comfortable and cool environment
- f. Excitement and stress
 - i. Minimize with the use of sedative medications
- g. Monitor RR, RE, and SpO2 minimally. Monitoring pCO2 will determine adequacy of ventilation.
- h. Tracheostomy care if needed
- VII. Complications and prognosis
 - a. Stenotic nares
 - i. Asymmetry
 - ii. Dehiscence
 - iii. Pawing, scratching
 - iv. Bleeding and aspiration of blood clots
 - v. Hypopigmentation
 - vi. Inadequate enlargement and persistent upper airway noise and obstruction
 - b. Elongated soft palate
 - i. Coughing
 - ii. Pharyngeal edema
 - iii. Bleeding
 - iv. Respiratory obstruction
 - v. Nasopharyngeal aspiration
 - vi. Aspiration pneumonia
 - vii. Death
 - c. Laryngeal collapse
 - i. Sacculectomy
 - 1. Coughing
 - 2. Pharyngeal edema
 - 3. Bleeding
 - 4. Granulation tissue formation
 - 5. Respiratory obstruction
 - 6. Inadvertent vocal cordectomy
 - 7. Death
 - ii. Unilateral arytenoid lateralization
 - 1. Coughing
 - 2. Pharyngeal edema

- 3. Seroma
- Respiratory obstruction
 Aspiration pneumonia 25% lifetime risk
- 6. Death
- iii. Permanent tracheostomy
 - 1. Mucus plug formation
 - 2. Aspiration
 - 3. Water
 - 4. Particulate material
 - 5. Respiratory obstruction
 - 6. Death

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June 4-6, 2023

Cystotomy and Perineal Urethrostomy- Easier Said than Done? Tips for Success and When to Refer

Heidi Phillips, BA, VMD, DACVS–SA, University of Illinois



Feline Perineal Urethrostomy Heidi Phillips VMD, DACVS-SA Associate Professor Small Animal Surgery University of Illinois

- I. Indications
 - a. Permanent damage to the penile urethra (caudal to the ischium), such as from trauma, neoplasia, immovable calculus, stricture
 - b. Life threatening or recurrent lower urinary tract obstruction
 - i. ONE episode of life-threatening urethral obstruction warrants consideration of PU!
- II. Pre-operative planning and discussion
 - a. The cat must be stabilized!
 - i. The cat should be adequately evaluated by complete blood count, serum biochemistry panel or NOVA panel, urinalysis +/- urine culture.
 - ii. Fluid resuscitation and correction of electrolyte and acid base disorders should be performed before consideration of surgery.
 - iii. The nature of the interruption of normal urine flow should be determined using survey abdominal radiographs, contrast abdominal radiographs, abdominal ultrasonography, or abdominal CT.
 - iv. Placement of a urinary catheter should be attempted to help differentiate amongst possible causes of interruption to normal urethral flow.
 - v. The hind limbs and perineal/perianal regions and tail base should be evaluated for evidence of swelling, temperature changes (hot or cold), discoloration, and firmness or pain associated with induration of fat and urine leakage subcutaneously.
 - b. Most cases that present for perineal urethrostomy are male cats with feline lower urinary tract disease or feline urological syndrome. In many of these cases, the obstruction of the urethra occurs in the distal penis, where the urethral opening is often < 1mm diameter.</p>
 - c. However, in some cases, more proximal disruptions can occur due to natural or iatrogenic trauma to the urethra, or proximal obstructions with calculi. It is very important to note, before proceeding with perineal urethrostomy, where is the exact or likely location of the trauma or obstruction and ensure that PU can be performed safely, effectively, and will bypass the area of concern!
 - i. In cases of urethral obstruction, unblocking the cat can provide tactile feedback concerning the level of obstruction
 - ii. If there is any concern, a retrograde urethrocystogram can be performed. If the cat cannot be catheterized routinely, a voiding cystourethrogram or fluoroscopically guided

percutaneous antegrade urethral catheterization can be performed with the aid of hydrophilic wires and help in characterizing the lesion.

- iii. In cases of obstruction or trauma cranial to the caudal edge of the ischium, PU cannot be safely performed. In these cases, a transpelvic urethrostomy or prepubic urethrostomy may be performed.
- III. Surgical procedure
 - a. The patient is clipped widely and aseptically prepared. Placement of a temporary purse string suture in the anus is helpful to prevent contamination of the surgical site during the procedure. The cat may be positioned in sternal or dorsal recumbency if a cystotomy is to be performed concurrently. Sternal recumbency will be described here.
 - b. The hindquarters should be positioned over the end of a well-padded perineal stand or tilted surgical table. Padding is essential to limit pressure on the femoral nerves. Appropriate positioning is critical. The cat's hindquarters should be tilted upward, and the cranial body tilted downward. The tail should be secured up over the cat's back, and the perineal area should be accessible.
 - c. The ischial tuberosities to provide perspective and orientation. The skin around the prepuce and scrotum should be incised using a #15 or #11 blade to create an ellipse. The dorsal point of the ellipse should commence at least 1-1.5 cm from the anus, but not much more.
 - d. The cat may be castrated at this time if needed, otherwise the scrotal vessels may require light cauterization.
 - e. The subcutaneous and perineal fat is dissected from dorsal, lateral, and ventral to the penis. Care is taken to palpate the penis by rolling between the fingers periodically.
 - f. Dissection toward the ischial tuberosities reveals the ischiocavernosus (IC) muscles bilaterally. I prefer to dissect and ligate the muscles to prevent bleeding before transecting them along the caudal edge of the ischium. Briefly, a mosquito hemostat or small blade is used to create a window in the periosteum and connective tissue ventral to the muscle but directly on the dorsum of the ischium. A hemostat is used to slightly enlarge this window and to create a window dorsal to the IC muscle as well. The hemostat is passed through the ventral window cranial, and then dorsal, to the IC muscle to exit through the dorsal window. A length of 4-0 PDS suture is passed into the jaws of the hemostat and around the muscle, and the muscle is ligated ~5 mm-1 cm lateral to the penis. The IC muscle is transected from the ischium for the muscle's entire attachment. This process is repeated on the opposite side. When the task is complete, an index finger should be able to be swept freely over each entire ischial tuberosity and lateral ischial table.
 - g. Attention is now directed to the ventral penile attachments along the dorsal ischial table. Using a combination of sharp dissection with iris

scissors and blunt dissection, the attachments are carefully freed by cutting close to the bone. Care is taken to not incise the ventral aspect of the urethra!

- h. Once the attachments are all dissected, the penis should be freely movable without any attachment to the ischium. This step is critical to ensure that the sutured PU site will not be under tension.
- i. The retractor penis muscle is dissected from the dorsum of the penis and transected just distal to the anus.
- j. The penis is partially transected just proximal to the site of obstruction and a shortened open-ended tomcat catheter is passed as a guide into the urethra.
- k. Using a #11 blade the dorsum of the penis is incised along its long axis over the catheter into the urethral lumen. Care is taken to make the cut in the urethra continuous to the level of the bulbourethral glands. At the proper level the pelvic urethra is 4 times wider than the penile urethra and can accommodate a hemostat to the level of the box locks or an 8 Fr catheter.
- The apex of the urethral incision is sutured to the apex of the skin incision using 4-0 or 5-0 non-absorbable suture in a simple interrupted pattern. The first 4-5 sutures should be placed as stay sutures so that accurate placement of each suture can be ensured. Once accuracy is confirmed, the stay sutures are tied and additional mucosa to skin sutures are placed from the urethral mucosa to the perineal skin along the lateral sides of the urethra. This creates a drainboard over which urine can flow.
- m. Once the transected area of the penis is reached, a transfixation ligature of 4-0 PDS is placed around the penis and the portion distal to the ligature resected.
- n. The area is flushed with sterile saline. The subcutaneous tissue remaining ventral to the drainboard is closed with a simple continuous pattern of 4-0 PDS. Two to three additional mucosal to skin sutures are placed along the ventral aspect of the drainboard.
- o. An Elizabethan collar is placed immediately to prevent licking or chewing of the anastomotic sutures on waking.
- p. The patient should be returned 7-10 days following surgery for sedation and suture removal. Removal of all sutures is completed by grasping one tag with a hemostat and cutting the loop of the suture carefully using suture scissors or a #11 blade.
- IV. Complications and prognosis
 - a. The cat should be treated preemptively for pain, and his comfort should be monitored closely. I prefer the use of methadone 0.2-0.25 mg/kg IV q6h. One-2 days following surgery, the cat may be switched to IV or sublingual buprenorphine 0.02 mg/kg q6-8h. I also prefer to maintain the cats on at least maintenance IV fluids to stimulate urination so that the area may be monitored for signs of urine leakage subcutaneously.

- b. Many cats will be uncomfortable and urinate on themselves or lay in urine the first 1-2 days after surgery. It is important to keep the perineal region clean and dry to prevent urine scald.
- c. Do NOT place a urinary catheter in the perineal site. At least one study has shown catheters in the healing site predispose to stricture formation.
- d. Stricture formation and subcutaneous urine leakage are the most common complications following PU. Subcutaneous urine leakage usually occurs in the first 1-3 days following surgery if sutures were placed inappropriately, or following trauma if the cat was able to lick of chew at the site. Inappropriate suture placement occurs when the urethral lining is not identified properly and sutured accurately to the perineal skin. Urine leakage should be suspected if the cat does not urinate appropriate volumes, strains to urinate, has asymmetrical swelling of the perineum, hind legs, or tail base, has bruising or pain in the perineal region, or if the perineal region is firm, painful, or shows changes in temperature to excessively warm or cool. Urine leakage must be treated aggressively with urethral catheterization or revision of the anastomotic site and flushing and debridement of the subcutaneous tissues. Skin sloughing may be significant in serious cases and warrant additional surgery and reconstruction.
- e. Stricture most commonly occurs as a result of inadequate dissection of the urethra from the ischium, causing tension on the surgical site, or sufficiently to the level of the bulbourethral glands, where the pelvic urethra is widest. Stricture is most commonly seen weeks to months after PU surgery, and is noted on examination in cats as a pinpoint skin opening through which a very small stream of urine passes. Alternatively, some cats present completely obstructed.
- f. Long-term, urinary tract infection is a possible complication due to the shortening and widening of the urethra that occurs with PU surgery, weakening natural defenses against ascending bacterial infection. Many cats may be asymptomatic for ascending urinary tract infection. Veterinarians should monitor for latent infections by performing regular urinalyses +/- urine culture via cystocentesis every 3-6 months. Latent infections not identified and treated properly can ascend to the kidneys and cause pyelonephritis.
- g. Hemorrhage is often seen from the inflamed urethra and is usually self-limiting and tolerated well by the patient.
- h. Other possible but extremely rare reported complications include perineal hernia and urinary incontinence.

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June 4-6, 2023

Thoracic Trauma-

Triage and Stabilization

Perioperative Consideration and Planning Post-Surgical Decision-Making, Care, and Prognosis

Heidi Phillips, BA, VMD, DACVS–SA, University of Illinois



THORACIC TRAUMA Heidi Phillips VMD, DACVS-SA University of Illinois College of Veterinary Medicine, Urbana, Illinois

Key Points:

- Prior to imaging and wound evaluation, however, appropriate triage and patient stabilization are required. Administration of oxygen, crystalloid fluid therapy, and possibly blood products should be considered.
- Thoracostomy should be considered after any thoracic surgery and for the removal of persistent accumulations of air, for flail chest or other causes of tension pneumothorax, and for accumulations of fluid such as hemorrhage.
- Overall mortality ranges from 10-15% in dogs and cats and may result from hypotension, hypoventilation, hypoxemia, SIRS, vasculitis, DIC and MODS, interstitial edema, fluid overload, and loss of peripheral venous access.

The thoracic wall is relatively resistant to trauma, and blunt trauma such as from motor vehicle accidents may cause leakage of air or hemorrhage into the pleural space that is self-limiting or responsive to one or two thoracocenteses. However, penetrating thoracic trauma, as occurs with bite wounds or projectile injury is likely to require adept emergent care and definitive surgical repair. Thoracic trauma associated with bite wounds has been shown to result in rib fracture, pneumothorax from environmental air entry through the chest wall or escape from pulmonary lacerations, flail chest, pulmonary contusion, and contaminated pleural effusions which, if left untreated, may result in pyothorax. Management of thoracic wall trauma must consider the likelihood of injury to internal thoracic structures or contamination of the intrathoracic space. Unfortunately, aside from revealing pleural air and rib fractures, radiography has been shown to be not helpful in determining which patients suffering from thoracic trauma require surgery. Computed tomography, however, may be more helpful in identifying breaches in the thoracic wall.

Prior to imaging and wound evaluation, however, appropriate triage and patient stabilization are required. Administration of oxygen, crystalloid fluid therapy, and possibly blood products should be considered. Physical examination assessment of HR and RR and careful auscultation should help reveal which patients need thoracocentesis. Open wounds should be covered immediately, and the patient placed in sternal recumbency. The thoracic wall should be rapidly clipped and aseptically prepared. Thoracocentesis may be performed with a needle, overthe-needle catheter, or transthoracic needle. Use of an extension set with 3-way stop cock and syringe helps to prevent inadvertent further air accumulation as well as dangerous movement of the needle during aspiration attempts. The needle should be inserted in the dorsal third of the chest for air retrieval and ventral 2/3 for fluid removal. The needle should be inserted with the bevel perpendicular to the thoracic wall in 7th-9th intercostal spaces just cranial to a rib to avoid laceration of the intercostal neurovascular bundle. Once the pleural space is penetrated, the

needle should be changed in angle to 45 degrees with the bevel facing the lung to minimize the chance of lung laceration.

Thoracostomy should be considered after any thoracic surgery and for the removal of persistent accumulations of air, for flail chest or other causes of tension pneumothorax, and for accumulations of fluid such as hemorrhage, pus, or chyle after repeated thoracocentesis. Because the thoracic wall and lungs are inherently and functionally linked by negative intrapleural pressures and a very slight amount of pleural fluid, pulmonary compliance is a function of the summed compliance of the thoracic wall and lungs and relies on maintenance of coupling of the lungs to the thoracic wall by negative intrapleural pressures. Flail chest may result in paradoxical ventilation as a result of instability of the chest wall. Tension pneumothorax severely compromises cardiopulmonary and vascular function and can be quickly fatal.

Commercial thoracostomy tubes have radiopaque markings and multiple fenestrations. Modern tubes are light, flexible, and relatively comfortable, and some come with a stylet system or are placed with Seldinger technique. Tubes should be chosen based on patient size, but also with consideration toward the material being removed. For example, removal of pus will require a large bore tube than removal of serous fluid or air. In general, large or giant breed dogs should receive tubes sized 20-24 Fr, medium sized dogs 14-18 Fr, and small dogs and cats 8-12 Fr. Prior to placement, the tube should be premeasured to not encroach on the cranial mediastinum and thoracic inlet. A skin incision should be made around the 10-11th intercostal space. The tube should then be tunneled cranially 2-3 spaces to be inserted between the 8-10th intercostal spaces. The tube should be inserted to the pre-measured point and secured with a purse string suture and finger trap pattern. I prefer to place adaptors and injection caps securely by attachment with orthopedic wire to the tube to ensure security of the apparatus. The tube should be used to remove as much air or fluid as possible to obtain negative pressure. The insertion site should be covered with an antibiotic cream and thin non-adherent bandage and the chest covered with stockinette material. Radiographs should be taken with two orthogonal views to ensure accurate placement. Aspiration of the tube should occur every 4-6 hours using sterile technique and the amount of air or fluid evacuated quantified and recorded. Between aspirations a clamp should be closed across the tube to prevent inadvertent entry of air into the chest should the tubeadaptorinjection cap system fail. Continuous pleural drainage should be considered for all cases of rapidly accumulating air.

Removal of the thoracostomy tube should be dictated by the clinical status of the patient. However, following definitive surgery, when no air and minimal volumes of minimally inflammatory fluid are removed from the chest (<3-5 ml/kg/d in dogs and 5 ml/kg/d in cats), removal may be considered. At times, volumes of fluid obtained will not reach these described minimums, and removal of the tube may be considered when fluid volumes plateau and the fluid is cytologically benign.

Temporary tracheostomy may be indicated for the treatment of thoracic trauma patients with upper airway obstruction due to concurrent upper airway trauma. Always maintain a tracheostomy pack at the ready in your emergency facility. Such a pack should include a fenestrated sterile drape, 4x4 or 3x3 sterile gauze, self-retaining retractors such as small Gelpi or

Weitlaner retractors, several mosquito hemostats, atraumatic forceps such as Debakey forceps, other forceps such as Brown-Adson forceps, Metzebaum scissors, mayo scissors, and suture scissors. A selection of cuffed or non-cuffed tracheostomy tubes should also be available. A tube sized to occupy about 60-70% of the tracheal lumen is ideal.

There are several important points to consider when contemplating temporary tracheostomy. When given the luxury of a planned temporary tracheostomy, as much patient preparation should be performed in advance as possible. Prior to anesthesia for a complex or risky procedure such as tracheobronchoscopy, the ventral neck should be clipped and minimally prepared with surgical antiseptic solution. Sterile gloves, the tracheostomy pack and adaptors for connecting the endotracheal tube to the tracheostomy tube should be available. If oral intubation is possible, tracheostomy may proceed at a more relaxed pace with precise technique. If oral intubation is not possible, and tracheostomy must be performed on an unanticipated basis, patient preparation must proceed very swiftly. Two to three swipes of the ventral cervical midline with hair clippers and surgical antiseptic may be all that is possible. Surgery should then proceed as quickly as possible with as much care as possible to ensure a rapid intubation.

Central venous catheter placement is often important to consider in dogs and cats that have experienced significant thoracic trauma, especially penetrating thoracic trauma. Inflammation is often widespread and severe in these cases, and may lead to SIRS and vasculitis, interstitial edema, and loss of peripheral venous access. Hypotension, multiorgan dysfunction, fluid overload, and death may result. Other common indications for central venous catheter placement include hemodynamic monitoring of central venous blood pressure, medication and nutrient administration, and need for repeated blood sampling with minimal restraint and without additional venipunctures.

A jugular vein is used most commonly; however, caudal vena cava access via a peripheral vein is possible with the peripherally inserted central catheter (PICC) technique. Medial and lateral saphenous veins are used most commonly during PICC placement. Catheters types for central vein placement include through-the-needle, over-the-needle, and long singlelumen catheters. Multilumen catheters with two, three, or four ports provide long-term vascular access for multiple concurrent uses in critically ill patients. The Seldinger technique can be used for insertion of single-lumen catheters, multilumen catheters, or percutaneous catheter introducer systems, such as those used to facilitate placement of a pulmonary artery catheter or transvenous pacing lead. Before multilumen central venous catheter placement, the required catheter length is estimated by measuring from the jugular access site to the caudal aspect of the ipsilateral triceps muscle or first rib.

For central venous blood pressure monitoring, the catheter tip should reside within the thoracic cavity in the cranial vena cava just cranial to the right atrium. Strict aseptic technique should be used. The patient should be clipped widely in the area of catheter placement, the site should be aseptically prepared and draped, and the operator should wear sterile gloves. A cap, mask, and gown may also be considered, depending on the immune or infectious disease status of the patient. All ports of the catheter should be flushed with sterile, heparinized saline, and the

distal most port should be identified because this is the port through which the guidewire will pass. A small stab incision is made in the skin with a number 11 blade over the jugular vein midway between the angle of the mandible and the point of the shoulder. A short over-the-needle catheter is inserted through the stab incision and into the jugular vein. The guidewire is passed carefully through the needle and threaded into the vein for two-thirds to three-fourths of its length or until it is securely seated within the vessel. The needle is removed over the guidewire, which is carefully held to maintain venous access. A vessel dilator is threaded and twisted axially over the wire through the wall into the lumen of the vessel to dilate the vessel and is then removed. The multilumen catheter is inserted over the guidewire until the proximal end of the guidewire protrudes from the most distal port of the catheter. This portion of the wire is grasped and held firmly while the catheter is advanced into the vessel over the wire. After the catheter has been inserted to its pre-measured length, the guidewire is removed. All of the ports of the catheter are aspirated with a syringe until blood is seen at each port and all air is removed. Each port is then flushed with heparinized saline and capped. The catheter is secured to skin with multiple sutures, and the area is covered with a sterile dressing. Inadvertent contamination of the central venous catheter can have far more deleterious consequences than similar compromise of a peripheral catheter, and care must be taken to keep all connection sites of the catheter and intravenous lines clean and free of contamination or foreign debris. All unused ports should be occluded by a catheter lock when not in use. Authors of a recent publication comparing a modification of the Seldinger technique and a through-the-needle technique for jugular catheter placement in the dog concluded both techniques were relatively easily mastered by entry-level veterinarians. Hematomas formed using the through-the-needle technique were significantly larger than those formed using the Seldinger technique.

Surgical exploration of bite wounds is indicated when wounds penetrate the thoracic cavity or are deep, when there is significant muscle, subcutaneous tissue, or skin trauma, when pneumothorax is persistent or recurrent, or other surgical conditions such as lung lobe laceration, lung lobe herniation, diaphragmatic hernia, or body wall hernia are present. Bite wound exploration is performed by incision over the affected area with excision of the bite wound itself. I prefer to extend each bite wound dorsally and ventrally along the intercostal space to permit proper exploration of the deeper tissues. The skin, subcutaneous tissues, thoracic wall, and lungs are debrided or excised as needed. The thoracic cavity is filled with saline and positive pressure ventilation breath holds performed to evaluate for lung laceration. It is wise to appose rib fractures using a K-wire or Steinmann pin to drill a small hole into each rib end. Suture is then used to lightly appose the rib edges to prevent further laceration or penetration of lung lobes.

It is not uncommon in cases where the wounded animal has been bitten *and* shaken that avulsion injury of thoracic wall musculature occurs in addition to penetrating injury of the thoracic wall. The avulsion injury causes skeletonization of the ribs, sometimes completely stripping them of intercostal and other thoracic muscle origins or insertions. In such a situation, soft tissue closure of the thoracic wall may be difficult if not impossible using intercostal musculature alone. In some cases, a basket-weave pattern of rib and muscle apposition may permit restoration of a soft tissue seal over the thoracic wall. However, I have had to use latissimus dorsi or pectoral muscle flaps to provide a healthy and secure thoracic wall closure.

Use of autologous tissue is highly recommended to bring blood supply to the area, and synthetic implants should be avoided due to the potential to act as niduses for potentiation of contamination.

Superficial wound debridement and closure is required for many thoracic trauma cases. However, triage of the wound and first aid prior to definitive thoracotomy are often indicated. The patient should be stabilized after assessment of the airway, breathing status, and cardiovascular status as above. After the patient has been stabilized appropriately, it is necessary to clip, cleanse, assess, cover, and coapt any open wounds. The clinician or surgeon should use aseptic technique at all times, meaning, at a minimum, donning of a cap, surgical mask, and sterile gloves. Sterile drapes or huck towels and the use of sterile instruments is also required. Fill the wound with sterile, water-soluble gel. Clip all the way to wound's edges and prepare as for aseptic surgery.

Any tissue that is dead, no matter how vital, must be resected. A surgeon can be liberal with fat and sometimes muscle removal during debridment due to overlapping muscle function and the relatively avascular nature of fat. However, one should exercise caution with skin, and in the areas of other vital structures such as tendons, ligaments, blood vessels and nerves. During wound debridement, to accurately assess tissue viability, evaluate the color, thickness, and temperature of the tissue, seek evidence of arterial bleeding, and consider allowing time for "declaration" of viability over several days with serial wound debridements.

Irrigation of the wound can be performed with several fluid types. Tap water is hypotonic but has been shown to result in decreased infection rates as compared to saline. Nevertheless, sterile saline is used most commonly and is effective. Other options include the use of balanced ionic fluids and antiseptic infused solutions. Chlorhexidine gluconate 2% aqueous solution may be added to irrigation solutions at a ratio of 1:40. Such a dilution results in a 0.05% solution- one that is effective against bacteria but not harmful to fibroblasts and other cells present in the wound.

A balance of pressure and volume during lavage is critical. Generally, pressures forceful enough to irrigate bacteria and debris out of the wound but not drive them deeper into the wound are most useful. Pressures of 6-8 psi are utilized most often, and can be achieved with the use of a 1L fluid bag, drip set, 18 gauge needle or catheter, and pressure bag set to 250-300 mmHg.

Antimicrobial therapy should be based upon culture and sensitivity results. If indicated, empiric use may be based on gram stain of wounds following initial clip, cleansing, and irrigation.

A modified Robert Jones bandage can be applied for covering and coaptation of the wound and to protect a thoracostomy tube from contamination. The bandage should be monitored for strike through and to prevent additional contamination. Hypertonic saline 20% facilitates autolytic debridement. Honey provides a low hydrogen peroxide content with

antibacterial capability. It is also hyperosmotic, reducing edema and inflammation and enhancing granulation tissue formation. Sugar is also hyperosmotic and reduces edema and inflammation. Topical antimicrobial ointments such as triple antibiotic reduce surface bacterial counts. Silver is antibacterial for infected wounds and burns and is found in many topical wound dressings and creams. Hydrogels are hydrophilic and useful for wounds with minimal to no exudate as they maintain moisture and promote epithelialization. Hydrocolloids are useful for wounds with moderate to copious exudate, enhance autolytic debridement, and facilitate granulation tissue formation. Alginate is useful for wounds with moderate to copious exudate, enhance autolytic debridement, and facilitates granulation tissue formation.

Primary wound closure (first intension healing) is indicated for fresh wounds created by sharp injury or for penetrating wounds following debridement and irrigation- this is the type of wound closure most indicated following debridement of penetrating thoracic wounds. Delayed primary closure may be indicated for contaminated wounds readily made clean by 2-3 days of open wound management or if superficial tissue health is questionable and serial wound assessments are required for declaration of viability. Delayed primary closure is the closure of a wound before the development of granulation tissue. Second intention healing is not commonly indicated for wounds overlying the thorax but may be used to treat superficial contaminated wounds overlying the thorax where loss of tissue has occurred. Healing occurs by formation of granulation tissue, contraction, and epithelialization. Secondary closure (third intention healing) is indicated for contaminated wounds made clean by open wound management and applies to wounds closed over a granulation bed.

Hypoventilation is a serious risk following thoracic wall penetration, exploration, and reconstruction. Depending on the degree of inflammation and damage to or loss of pulmonary tissues, positive pressure ventilation may be required to maintain oxygenation, ventilation, and perfusion. This is another situation in which temporary tracheostomy may be applied.

Post-operative care and monitoring should include, at a minimum, IV fluids, consideration of blood products, evaluation of CBC, SBP, arterial or venous blood gases, and coagulation panels, continuous ECG, NIBP or direct arterial pressure assessment, weighing several times daily, monitoring of USG, measurement of urine output and drain production as part of assessing total volume in and out of the patient, monitoring of HR, RR and respiratory effort, and evaluation of SpO2. Analgesia is a very important aspect of management of thoracic trauma, and consideration should be given at the time of surgery to local nerve blocks with lidocaine 2%, bupivacaine, or liposomal bupivacaine. Bupivicaine can also be placed, diluted 1:1 with sterile saline at a dose of 1.5 mg/kg, into the thoracostomy tube q6-8h. Constant rate infusions of fentanyl (3-5 ug/kg/hr), lidocaine (30-50 ug/kg/min) and ketamine (3-5 ug/kg/min) are commonly used separately or concurrently in our hospital. After 1-2 days, intermittent injections of hydromorphone 0.1 mg/kg or methadone 0.2-0.25 mg/kg can be considered upon discontinuation of CRIs. Administration of medications such as gabapentin 8-15 mg/kg PO g812h can also be considered once the patient is able to receive oral medications. NSAIDs may be given if there are no contraindications, or grapiprant can be considered for anti-inflammatory treatment in patients with renal or liver impairment or gastrointestinal distress.

Mortality associated with extensive thoracic penetrating trauma historically ranges from 11-15.5%. As mentioned, mortality may result from hypotension, hypoventilation, hypoxemia, SIRS, vasculitis, DIC and MODS, interstitial edema, fluid overload, and loss of peripheral venous access. Wound complications are observed in a similar number of animals. Flail chest, diaphragmatic hernia, and pleural effusions have been associated with higher risks for mortality in cases of penetrating thoracic injury. In a recent article evaluating dogs with thoracic trauma, 85.4% of dogs survived to discharge. Female dogs and dogs that did not experience cardiac arrest as a postoperative complication had odds of survival 6 times and 102 times, respectively, those of male dogs and dogs that did experience cardiac arrest as a postoperative complication. In a similar article evaluating cats with thoracic trauma, 35% of cats experienced a dog bite or attack, 9% had another animal attack, and 4% had projectile penetrating trauma. Intrathoracic surgery was required for 65% of cats. The overall perioperative mortality rate was 13%. Nineteen of 20 cats with no cardiopulmonary arrest survived to discharge, compared with 1 of 3 cats with cardiopulmonary arrest. Only these 2 variables were significantly associated with outcome.

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