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EFFUSION CYTOLOGY IMAGE GALLERY

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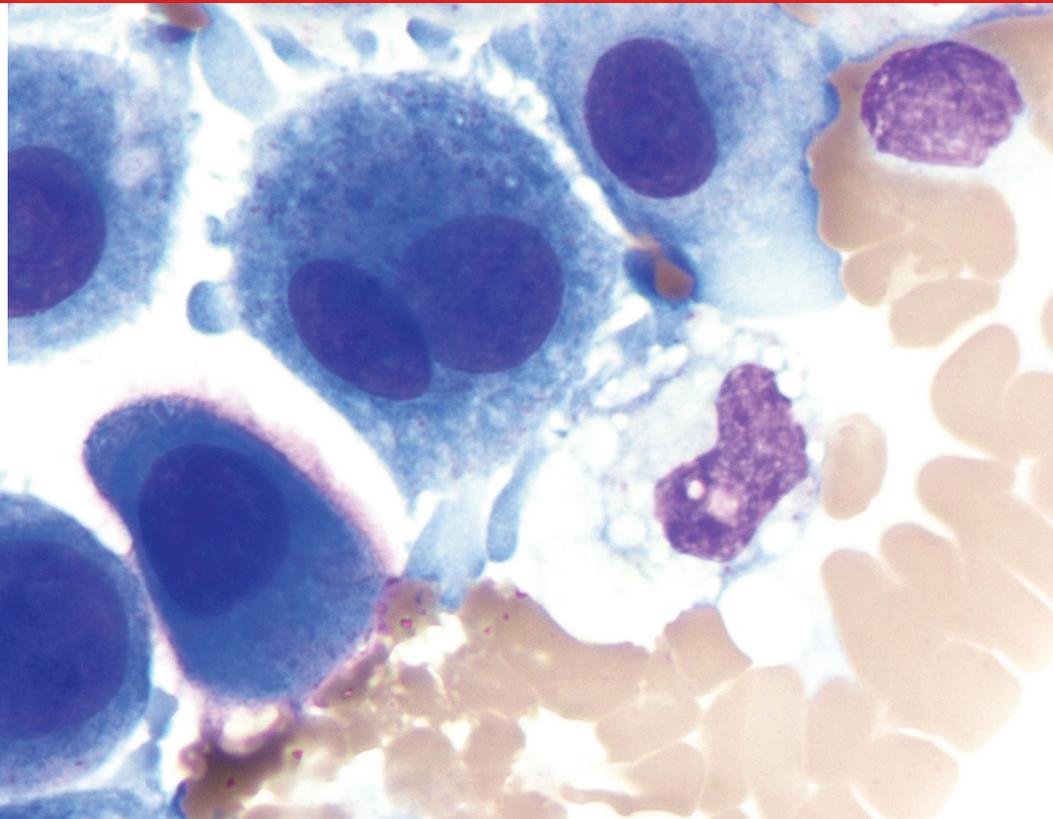
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Volume 18 Number 3



WSAVA
Global Veterinary Community

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DES MÉDECINS VÉTÉRIAIRES



(florfenicol, terbinafine, mometasone furoate)
Otic Solution

BE A HERO WITH CLARO[®]

(florfenicol, terbinafine, mometasone furoate) Otic Solution

**Guarantee compliance and
make ear infections easier**

Treat your patients' most common otitis externa
infections with one dose administered by you.



SAVE THE DAY. USE CLARO[®] FOR YOUR MOST COMMON OTITIS CASES.

Claro[®] is indicated for the treatment of otitis externa in dogs associated with susceptible strains of yeast (*Malassezia pachydermatis*) and bacteria (*Staphylococcus pseudintermedius*).

CAUTION: Federal (U.S.A.) law restricts this drug to use by or on the order of a licensed veterinarian. CONTRAINDICATIONS: Do not use in dogs with known tympanic membrane perforation. CLARO[®] is contraindicated in dogs with known or suspected hypersensitivity to florfenicol, terbinafine hydrochloride, or mometasone furoate.

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See page 2 for product information summary.

[BayerDVM.com/Claro](https://www.BayerDVM.com/Claro)

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**(florfenicol, terbinafine, mometasone furoate)
Otic Solution**

Antibacterial, antifungal, and anti-inflammatory
For Otic Use in Dogs Only

CAUTION: Federal (U.S.A.) law restricts this drug to use by or on the order of a licensed veterinarian.

DESCRIPTION:

CLARO® contains 16.6 mg/mL florfenicol, 14.8 mg/mL terbinafine (equivalent to 16.6 mg/mL terbinafine hydrochloride) and 2.2 mg/mL mometasone furoate. Inactive ingredients include purified water, propylene carbonate, propylene glycol, ethyl alcohol, and polyethylene glycol.

INDICATIONS:

CLARO® is indicated for the treatment of otitis externa in dogs associated with susceptible strains of yeast (*Malassezia pachydermatis*) and bacteria (*Staphylococcus pseudintermedius*).

DOSE AND ADMINISTRATION:

Shake before use.

CLARO® should be administered by veterinary personnel.

Administer one dose (1 dropperette) per affected ear. The duration of effect should last 30 days.

- Clean and dry the external ear canal before administering the product.
- Verify the tympanic membrane is intact prior to administration.
- Remove single dose dropperette from the package.
- While holding the dropperette in an upright position, remove the cap from the dropperette.
- Turn the cap over and push the other end of the cap onto the tip of the dropperette.
- Twist the cap to break the seal and then remove cap from the dropperette.
- Screw the applicator nozzle onto the dropperette.
- Insert the tapered tip of the dropperette into the affected external ear canal and squeeze to instill the entire contents (1 ml) into the affected ear.
- Gently massage the base of the ear to allow distribution of the solution.
- Repeat with other ear as prescribed.

Cleaning the ear after dosing may affect product effectiveness.

CONTRAINDICATIONS:

Do not use in dogs with known tympanic membrane perforation (see **PRECAUTIONS**). CLARO® is contraindicated in dogs with known or suspected hypersensitivity to florfenicol, terbinafine hydrochloride, or mometasone furoate.

WARNINGS:

Human Warnings: Not for use in humans. Keep this and all drugs out of reach of children. In case of accidental ingestion by humans, contact a physician immediately. In case of accidental skin contact, wash area thoroughly with water. Avoid contact with eyes. Humans with known hypersensitivity to florfenicol, terbinafine hydrochloride, or mometasone furoate should not handle this product.

PRECAUTIONS:

Do not administer orally.

The use of CLARO® in dogs with perforated tympanic membranes has not been evaluated. The integrity of the tympanic membrane should be confirmed before administering the product. Reevaluate the dog if hearing loss or signs of vestibular dysfunction are observed during treatment. Use of topical oral corticosteroids has been associated with adrenocortical suppression and iatrogenic hyperadrenocorticism in dogs (see **ANIMAL SAFETY**).

Use with caution in dogs with impaired hepatic function (see **ANIMAL SAFETY**).

The safe use of CLARO® in dogs used for breeding purposes, during pregnancy, or in lactating bitches has not been evaluated.

ADVERSE REACTIONS:

In a field study conducted in the United States (see **EFFECTIVENESS**), there were no directly attributable adverse reactions in 146 dogs administered CLARO®.

To report suspected adverse drug events and/or obtain a copy of the Safety Data Sheet (SDS) or for technical assistance, contact Bayer HealthCare at 1-800-422-9874.

For additional information about adverse drug experience reporting for animal drugs, contact FDA at 1-888-FDA-VETS or online at <http://www.fda.gov/AnimalVeterinary/SafetyHealth>.

PHARMACOLOGY:

CLARO® Otic Solution is a fixed combination of three active substances: florfenicol (antibacterial), terbinafine (antifungal), and mometasone furoate (steroidal anti-inflammatory). Florfenicol is a bacteriostatic antibiotic which acts by inhibiting protein synthesis. Terbinafine is an antifungal which selectively inhibits the early synthesis of ergosterol. Mometasone furoate is a glucocorticosteroid with anti-inflammatory activity.

MICROBIOLOGY:

The compatibility and additive effect of each of the components in CLARO® solution was demonstrated in a component effectiveness and non-interference study. An *in vitro* study of organisms collected from clinical cases of otitis externa in dogs enrolled in the clinical effectiveness study determined that florfenicol and terbinafine hydrochloride inhibit the growth of bacteria and yeast commonly associated with otitis externa in dogs. No consistent synergistic or antagonistic effect of the two antimicrobials was demonstrated. The addition of mometasone furoate to the combination did not impair antimicrobial activity to any clinically significant extent.

In a field study (see **EFFECTIVENESS**), at least 10 isolates from successfully treated cases were obtained for *S. pseudintermedius* and *M. pachydermatis*.

EFFECTIVENESS:

In a well-controlled, double-masked field study, CLARO® was evaluated against a vehicle control in 221 dogs with otitis externa. One hundred and forty six dogs were treated with CLARO® and 75 dogs were treated with the vehicle control. All dogs were evaluated for safety. Treatment (1 mL) was administered once on Day 0 to the affected ear(s). Prior to treatment, the ear(s) was cleaned with saline. The dogs were evaluated on Days 0, 7, 14, and 30. Blood work and urinalysis were obtained on Day 0 pre-treatment and Day 30 at study completion. Four clinical signs associated with otitis externa were evaluated: erythema, scudate, swelling, and ulceration. Success was based on clinical improvement at Day 30. Of the 183 dogs included in the effectiveness evaluation, 72.5% of dogs administered CLARO® solution were successfully treated, compared to 11.1% of the dogs in the vehicle-control group (p=0.0001).

ANIMAL SAFETY:

In a target animal safety study, CLARO® was administered aurally to 12-week-old Beagle puppies (4 dogs/sex/group) at DX, 1X, 3X, and 5X the recommended dose once every 2 weeks for a total dosing period of 28 days (3 times the treatment duration). No clinically relevant treatment-related findings were noted in hearing tests, body weight, weight gain, or food consumption. CLARO® administration was associated with post-treatment ear wetness or clear aural exudate, increased absolute neutrophil count, decreased absolute lymphocyte and eosinophil counts, suppression of the adrenal cortical response to ACTH-stimulation, decreased adrenal weight and atrophy of the adrenal cortex, increased liver weight with hepatocellular enlargement/cytoplasmic change, and decreased thymus weight. Other potentially treatment-related effects included mild changes to AST, total protein, inorganic phosphorus, creatinine, and calcium.

STORAGE INFORMATION:

Store between 20°C – 25°C (68°F – 77°F), excursions are permitted 15°C – 30°C (59°F – 86°F).

HOW SUPPLIED:

CLARO® solution is supplied in a single-use dropperette in a blister. Each dropperette contains one 1 mL dose.

CLARO® is available in cartons of two, ten, or twenty dropperettes.

Manufactured for
Bayer HealthCare LLC, Animal Health Division
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LV1802



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DIFFERENTIAL DIAGNOSIS PAGE 15



FENWAY CHANG, BVM, is working to complete her MS in small animal medicine at Free University in Berlin, Germany. Dr. Chang earned her veterinary degree from National Taiwan University and completed an emergency and critical care internship at Animal Emergency Center in Milwaukee, Wisconsin. Her clinical interests include fluid therapy, diagnostic imaging, and wound management.

CASE IN POINT PAGE 22



TIMOTHY M. FAN, DVM, PhD, DACVIM (Oncology, Internal Medicine), is the principal investigator of the Comparative Oncology Research Laboratory at University of Illinois at Urbana-Champaign, where he also earned his PhD in tumor immunology. He earned his DVM from Virginia-Maryland College of Veterinary Medicine in Blacksburg, Virginia, completed a small animal rotating internship at University of Illinois, and completed a small animal internal medicine residency at Cornell University. Dr. Fan's interests include rapidly investigating and translating novel treatment strategies in dogs with spontaneously arising cancers and conducting meaningful comparative oncology research to aid in treating cancer in companion animals and humans.

CONSULT THE EXPERT PAGE 57



ANDREW LINKLATER, DVM, DACVECC, is the director of the residency program, trauma center, and emergency and critical care department at Lakeshore Veterinary Specialists in Glendale, Wisconsin. He earned his DVM from the Western College of Veterinary Medicine in Saskatoon, Canada. Dr. Linklater has authored 2 veterinary textbooks and dozens of publications. He enjoys lecturing worldwide. His professional interests include trauma, surgical emergencies, coagulation, and transfusion medicine.

CASE IN POINT PAGE 22



GOTTFRIED MORGENEGG, DVM, owns Tierzahnarzt in Obfelden, Switzerland. He earned his DVM from University of Zurich in Switzerland, after which he worked in general practice before specializing in dentistry. Dr. Morgenegg is the past president of the European Veterinary Dental Society and a member of the WSAVA dental guidelines committee. His primary focus is improving disease awareness and veterinary education and providing helpful tools for clinicians and pet owners.

WSAVA DENTAL SERIES PAGE 65



ANA NEMEČ, DVM, PhD, DAVDC, DEVDC, is a veterinary specialist and an assistant professor at Small Animal Clinic of the Veterinary Faculty in Ljubljana, Slovenia, where she also earned her DVM and PhD in biomedicine. Dr. Nemeč completed a residency in dentistry and oral surgery at University of California, Davis. She has been active in several international veterinary dentistry organizations. Her passion is teaching.

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BROOK A. NIEMIEC, DVM, DAVDC, DEVDC, FAVD, earned his DVM from University of California, Davis. He is a board-certified specialist in veterinary dentistry of both the American and European Veterinary Dental Colleges. In addition, he is a fellow in the Academy of Veterinary Dentistry. He is one of fewer than 10 veterinarians worldwide to hold all 3 of these certificates.

WSAVA DENTAL SERIES PAGE 65



M. JUDITH RADIN, DVM, PhD, DACVP (Clinical Pathology), is a Professor Emerita in the Department of Veterinary Biosciences at The Ohio State University. She earned her DVM from Cornell University and PhD in veterinary pathology from Colorado State University. Her clinical areas of interest are chemistry, cytology, hematology, and coagulation. Dr. Radin is a member of the Dorothy M. Davis Heart & Lung Institute and Center for Clinical Translational Research, where she studies cytokine and eicosanoid mediators of hypertension and cardiovascular disease. She is section editor of invited reviews, as well as an editorial board member, for *Veterinary Clinical Pathology*. Dr. Radin has served on and chaired the board-certifying examination committee of the American College of Veterinary Pathologists, and she is past-president of the American Society for Veterinary Clinical Pathologists.

IMAGE GALLERY PAGE 31



J. SCOTT WEESE, DVM, DVSc, DACVIM, is the editor in chief of *Clinician's Brief*. He is also the chief of infection control at Ontario Veterinary College in Ontario, Canada, and a veterinary internist and microbiologist. Dr. Weese's research interests are infectious and zoonotic disease, particularly of companion animals, as well as infection control, staphylococcal infections, *Clostridium difficile* infection, and antimicrobial therapy. He holds a Canada Research Chair in zoonotic disease.

PROCEDURES PRO PAGE 10

Continues on page 72

NexGard® (afoxolaner) Chewables

CAUTION: Federal (USA) law restricts this drug to use by or on the order of a licensed veterinarian.

Description:

NexGard® (afoxolaner) is available in four sizes of beef-flavored, soft chewables for oral administration to dogs and puppies according to their weight. Each chewable is formulated to provide a minimum afoxolaner dosage of 1.14 mg/lb (2.5 mg/kg). Afoxolaner has the chemical composition 1-Naphthalenecarboxamide, 4-[5-[3-chloro-5-(trifluoromethyl)-phenyl]-4, 5-dihydro-5-(trifluoromethyl)-3-isoxazolyl]-N-[2-oxo-2-[(2,2,2-trifluoroethyl)amino]ethyl].

Indications:

NexGard kills adult fleas and is indicated for the treatment and prevention of flea infestations (*Ctenocephalides felis*), and the treatment and control of Black-legged tick (*Ixodes scapularis*), American Dog tick (*Dermacentor variabilis*), Lone Star tick (*Amblyomma americanum*), and Brown dog tick (*Rhipicephalus sanguineus*) infestations in dogs and puppies 8 weeks of age and older, weighing 4 pounds of body weight or greater, for one month. NexGard is indicated for the prevention of *Borrelia burgdorferi* infections as a direct result of killing *Ixodes scapularis* vector ticks.

Dosage and Administration:

NexGard is given orally once a month, at the minimum dosage of 1.14 mg/lb (2.5 mg/kg).

Dosing Schedule:

Body Weight	Afoxolaner Per Chewable (mg)	Chewables Administered
4.0 to 10.0 lbs.	11.3	One
10.1 to 24.0 lbs.	28.3	One
24.1 to 60.0 lbs.	68	One
60.1 to 121.0 lbs.	136	One
Over 121.0 lbs.	Administer the appropriate combination of chewables	

NexGard can be administered with or without food. Care should be taken that the dog consumes the complete dose, and treated animals should be observed for a few minutes to ensure that part of the dose is not lost or refused. If it is suspected that any of the dose has been lost or if vomiting occurs within two hours of administration, redose with another full dose. If a dose is missed, administer NexGard and resume a monthly dosing schedule.

Flea Treatment and Prevention:

Treatment with NexGard may begin at any time of the year. In areas where fleas are common year-round, monthly treatment with NexGard should continue the entire year without interruption.

To minimize the likelihood of flea reinfestation, it is important to treat all animals within a household with an approved flea control product.

Tick Treatment and Control:

Treatment with NexGard may begin at any time of the year (see **Effectiveness**).

Contraindications:

There are no known contraindications for the use of NexGard.

Warnings:

Not for use in humans. Keep this and all drugs out of the reach of children. In case of accidental ingestion, contact a physician immediately.

Precautions:

Afoxolaner is a member of the isoxazoline class. This class has been associated with neurologic adverse reactions including tremors, ataxia, and seizures. Seizures have been reported in dogs receiving isoxazoline class drugs, even in dogs without a history of seizures. Use with caution in dogs with a history of seizures or neurologic disorders (see **Adverse Reactions** and **Post-Approval Experience**).

The safe use of NexGard in breeding, pregnant or lactating dogs has not been evaluated.

Adverse Reactions:

In a well-controlled US field study, which included a total of 333 households and 615 treated dogs (415 administered afoxolaner; 200 administered active control), no serious adverse reactions were observed with NexGard.

Over the 90-day study period, all observations of potential adverse reactions were recorded. The most frequent reactions reported at an incidence of > 1% within any of the three months of observations are presented in the following table. The most frequently reported adverse reaction was vomiting. The occurrence of vomiting was generally self-limiting and of short duration and tended to decrease with subsequent doses in both groups. Five treated dogs experienced anorexia during the study, and two of those dogs experienced anorexia with the first dose but not subsequent doses.

Table 1: Dogs With Adverse Reactions.

	Treatment Group			
	Afoxolaner		Oral active control	
	N ¹	% (n=415)	N ²	% (n=200)
Vomiting (with and without blood)	17	4.1	25	12.5
Dry/Flaky Skin	13	3.1	2	1.0
Diarrhea (with and without blood)	13	3.1	7	3.5
Lethargy	7	1.7	4	2.0
Anorexia	5	1.2	9	4.5

¹Number of dogs in the afoxolaner treatment group with the identified abnormality.

²Number of dogs in the control group with the identified abnormality.

In the US field study, one dog with a history of seizures experienced a seizure on the same day after receiving the first dose and on the same day after receiving the second dose of NexGard. This dog experienced a third seizure one week after receiving the third dose. The dog remained

enrolled and completed the study. Another dog with a history of seizures had a seizure 19 days after the third dose of NexGard. The dog remained enrolled and completed the study. A third dog with a history of seizures received NexGard and experienced no seizures throughout the study.

Post-Approval Experience (July 2018):

The following adverse events are based on post-approval adverse drug experience reporting. Not all adverse events are reported to FDA/CVM. It is not always possible to reliably estimate the adverse event frequency or establish a causal relationship to product exposure using these data.

The following adverse events reported for dogs are listed in decreasing order of reporting frequency for NexGard:

Vomiting, pruritus, lethargy, diarrhea (with and without blood), anorexia, seizure, hyperactivity/restlessness, panting, erythema, ataxia, dermatitis (including rash, papules), allergic reactions (including hives, swelling), and tremors.

Contact Information:

For a copy of the Safety Data Sheet (SDS) or to report suspected adverse drug events, contact Merial at 1-888-637-4251 or www.nexgardfordogs.com.

For additional information about adverse drug experience reporting for animal drugs, contact FDA at 1-888-FDA-VETS or online at <http://www.fda.gov/AnimalVeterinary/SafetyHealth>.

Mode of Action:

Afoxolaner is a member of the isoxazoline family, shown to bind at a binding site to inhibit insect and acarine ligand-gated chloride channels, in particular those gated by the neurotransmitter gamma-aminobutyric acid (GABA), thereby blocking pre- and post-synaptic transfer of chloride ions across cell membranes. Prolonged afoxolaner-induced hyperexcitation results in uncontrolled activity of the central nervous system and death of insects and acarines. The selective toxicity of afoxolaner between insects and acarines and mammals may be inferred by the differential sensitivity of the insects and acarines' GABA receptors versus mammalian GABA receptors.

Effectiveness:

In a well-controlled laboratory study, NexGard began to kill fleas four hours after initial administration and demonstrated >99% effectiveness at eight hours. In a separate well-controlled laboratory study, NexGard demonstrated 100% effectiveness against adult fleas 24 hours post-infestation for 35 days, and was ≥93% effective at 12 hours post-infestation through Day 21, and on Day 35. On Day 28, NexGard was 81.1% effective 12 hours post-infestation. Dogs in both the treated and control groups that were infested with fleas on Day -1 generated flea eggs at 12- and 24-hours post-treatment (0-11 eggs and 1-17 eggs in the NexGard treated dogs, and 4-90 eggs and 0-118 eggs in the control dogs, at 12- and 24-hours, respectively). At subsequent evaluations post-infestation, fleas from dogs in the treated group were essentially unable to produce any eggs (0-1 eggs) while fleas from dogs in the control group continued to produce eggs (1-141 eggs).

In a 90-day US field study conducted in households with existing flea infestations of varying severity, the effectiveness of NexGard against fleas on the Day 30, 60 and 90 visits compared with baseline was 98.0%, 99.7%, and 99.9%, respectively.

Collectively, the data from the three studies (two laboratory and one field) demonstrate that NexGard kills fleas before they can lay eggs, thus preventing subsequent flea infestations after the start of treatment of existing flea infestations.

In well-controlled laboratory studies, NexGard demonstrated >97% effectiveness against *Dermacentor variabilis*, >94% effectiveness against *Ixodes scapularis*, and >93% effectiveness against *Rhipicephalus sanguineus*, 48 hours post-infestation for 30 days. At 72 hours post-infestation, NexGard demonstrated >97% effectiveness against *Amblyomma americanum* for 30 days. In two separate, well-controlled laboratory studies, NexGard was effective at preventing *Borrelia burgdorferi* infections after dogs were infested with *Ixodes scapularis* vector ticks 28 days post-treatment.

Animal Safety:

In a margin of safety study, NexGard was administered orally to 8 to 9-week-old Beagle puppies at 1, 3, and 5 times the maximum exposure dose (6.3 mg/kg) for three treatments every 28 days, followed by three treatments every 14 days, for a total of six treatments. Dogs in the control group were sham-dosed. There were no clinically-relevant effects related to treatment on physical examination, body weight, food consumption, clinical pathology (hematology, clinical chemistries, or coagulation tests), gross pathology, histopathology or organ weights. Vomiting occurred throughout the study, with a similar incidence in the treated and control groups, including one dog in the 5x group that vomited four hours after treatment.

In a well-controlled field study, NexGard was used concomitantly with other medications, such as vaccines, anthelmintics, antibiotics (including topicals), steroids, NSAIDs, anesthetics, and antihistamines. No adverse reactions were observed from the concomitant use of NexGard with other medications.

Storage Information:

Store at or below 30°C (86°F) with excursions permitted up to 40°C (104°F).

How Supplied:

NexGard is available in four sizes of beef-flavored soft chewables: 11.3, 28.3, 68 or 136 mg afoxolaner. Each chewable size is available in color-coded packages of 1, 3 or 6 beef-flavored chewables.

NADA 141-406, Approved by FDA

Marketed by: Frontline Vet Labs™, a Division of Merial, Inc.
Duluth, GA 30096-4640 USA

Made in Brazil.

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From *Clinician's Brief* on Social Media

WE ASKED ...

What is the highest total thyroxine you have seen in a hyperthyroid cat?

“43!”—*Aimee C*

“26. I am in shelter medicine, and over the years I have seen several in the high teens and 20s.”—*Heather K*

“30. The poor cat showed every possible clinical sign. We treated her and she is now doing well with maintenance.”—*Ashley R*

What is your best veterinary Urban Dictionary entry?

 **chab·do·men**

/ˈCHAbdəmən, chabˈdōmən/

noun

An area on the body of a dog, cat, or similar mammal that is somewhat on the chest and somewhat on the abdomen and yet not really on either.



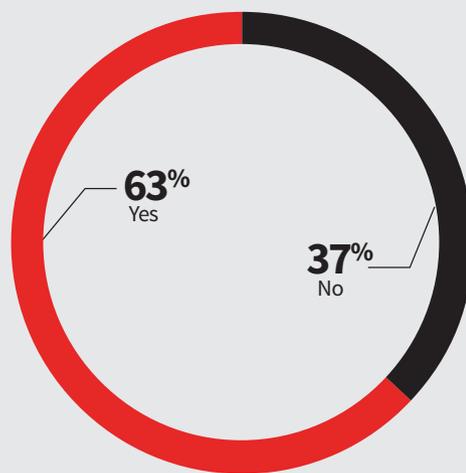
clinician's brief

“Shmelbow—thoracic limb lameness localized to the shoulder or elbow.”—*Kira P*

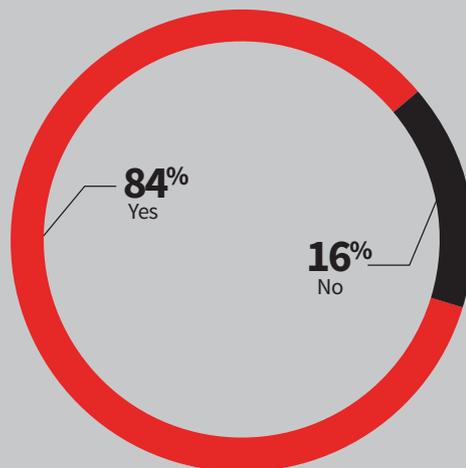
“Bladeral—right, lateral abdomen radiograph focused on the urinary bladder.”—*Chelsey M*

“Smeecal—when a fecal sample is dropped off for a smear and a float.”—*Jennifer B*

Do you ever induce vomiting for known GI foreign bodies?



Do you sterilize and reuse endotracheal tubes?



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Prescribe

peace of mind.

Powerful protection can also be gentle:

- ✓ Safe for puppies as young as 8 weeks of age weighing 4 lbs or more
- ✓ Over 223 million doses of afoxolaner have been prescribed¹
- ✓ And it's the only flea and tick control product indicated for the prevention of *Borrelia burgdorferi* infections as a direct result of killing *Ixodes scapularis* vector ticks

NexGard[®]
(afoxolaner) Chewables

What one little chew can do

¹Data on file.



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See page 4 for product information summary.

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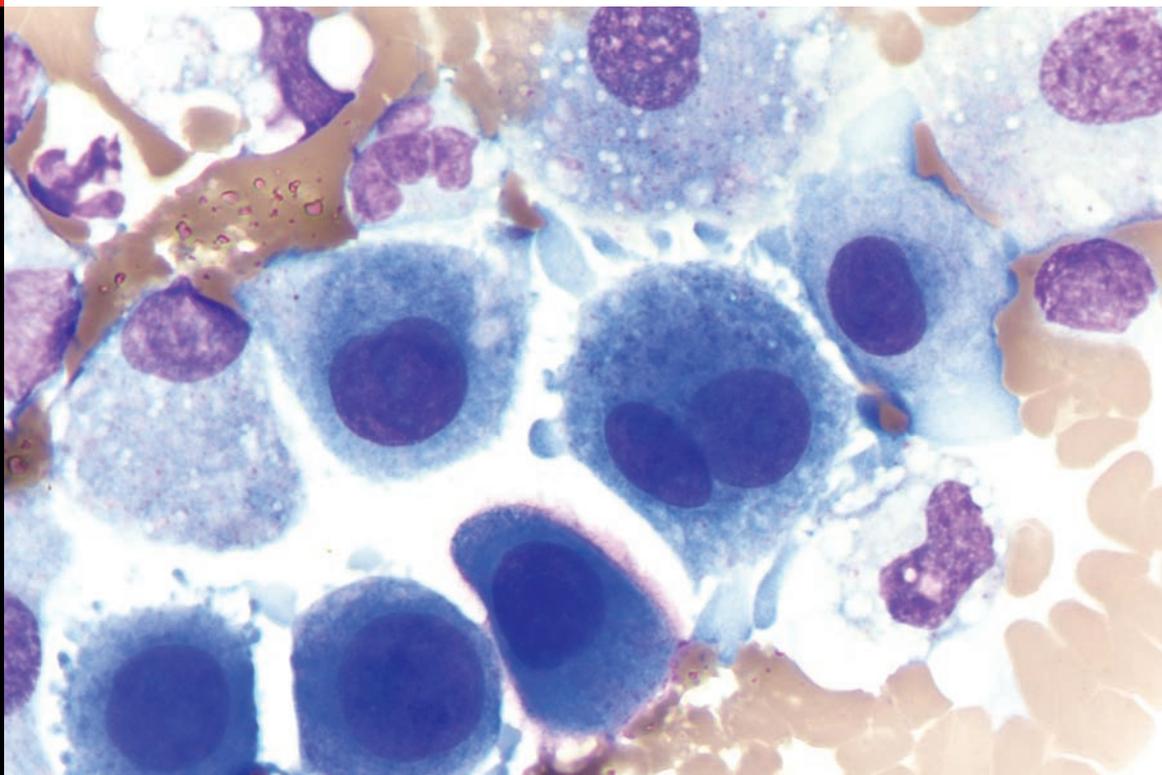
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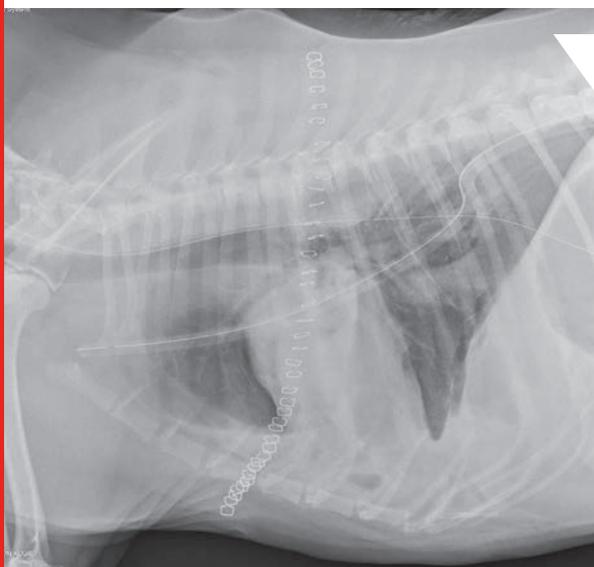
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NOTICE OF CORRECTION

In the Differential Diagnosis article for Hypokalemia, published in the November 2019 issue of *Clinician's Brief*, "hyperkalemic periodic paralysis" should have been "periodic hypokalemic polymyopathy." *Clinician's Brief* regrets the error.



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Leslie Sinn, CPDT-KA, DVM, DACVB
brief.vet/exam-room-behavior

PODCAST All About Vestibular Disease with Dr. Platt

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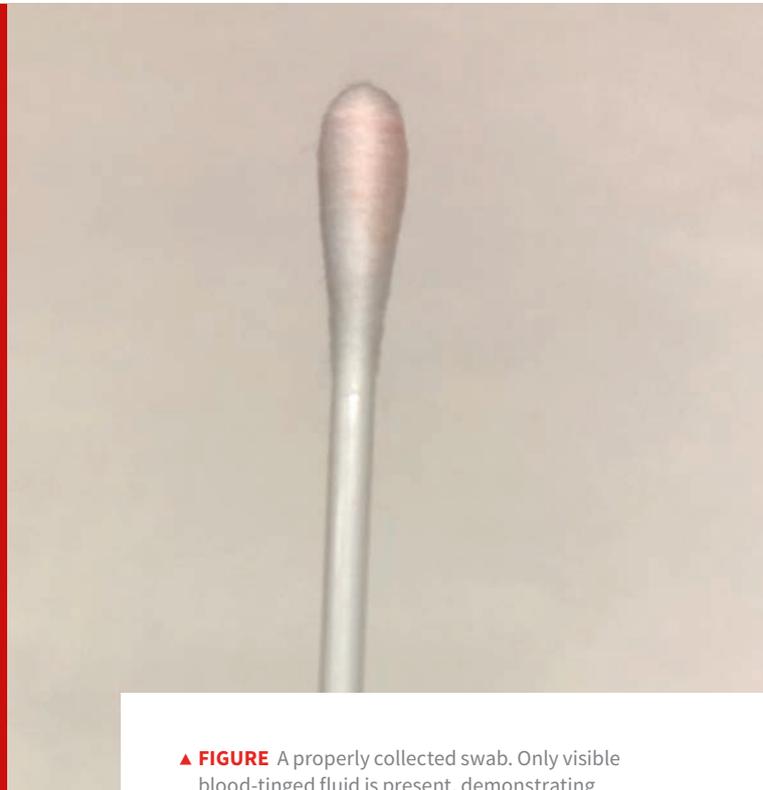
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Wound Sampling for Culture & Cytology

J. Scott Weese, DVM, DVSc, DACVIM
 Ontario Veterinary College
 Ontario, Canada



▲ **FIGURE** A properly collected swab. Only visible blood-tinged fluid is present, demonstrating that pus and necrotic debris were avoided.

Obtaining diagnostic specimens can be important for management of wound infections. Because wounds communicate with the external environment and body sites that harbor a commensal microbiota, proper technique is required to optimize sensitivity and specificity. A well-collected diagnostic specimen can help confirm the presence of bacterial infection, identify the causative organism, and provide critical antimicrobial susceptibility data. Poor sampling technique can complicate patient management by providing nondiagnostic or even misleading results.

Determining whether to collect a specimen and which diagnostic tests are necessary should be the first step. Although culture is useful in most situations, sampling

for culture is less important (or should be avoided) in cases for which systemic antimicrobial therapy is not likely needed, a proper representative sample cannot be collected, contamination is likely, or sampling may compromise unaffected sites.

Bacterial culture is useful when the disease process is unclear and/or when systemic antimicrobials are to be used. Culture is particularly important when there is a greater likelihood that resistant pathogens are involved, such as infections that have failed empiric treatment or infections in patients with a history of antimicrobial treatment and/or hospitalization.

Although culture is often the focus of wound sampling, cytology should be considered whenever a specimen is being collected for culture. A specimen should always be submitted for cytology, which can be useful to confirm the presence of bacterial infection, rule out other causes, corroborate culture results, or identify fastidious organisms. Beyond routine aerobic culture and cytology, addi-

tional testing may be indicated in some situations, particularly chronic infections, infections that have not responded to appropriate treatment, and infections that are clinically atypical. This could include addition of special stains (eg, acid-fast, periodic acid–Schiff) or fungal culture. Anaerobic culture may be indicated in infections potentially associated with a penetrating wound or those that have a clinical appearance suggestive of anaerobic infection (eg, emphysematous tissue).

Specimen Types

When possible, tissue samples should be collected for culture. Although more invasive than fine-needle aspirates or swabs, tissue samples can have a higher sensitivity and specificity, particularly with deeper infections in humans.^{1,2}

Fine-needle aspiration can be performed on deeper sites and are preferred over superficial swabs of draining tracts. The small volume collected and small area of the site sampled can limit sensitivity. Ideally, ≥ 2 samples should be collected, as positive results from >1 sample provide more convincing information of the clinical relevance of an isolated bacterial species.

Swabs are typically easier to collect and can be useful in many clinical situations. When performed properly, swabs are more prone to isolation of contaminants but yield fairly similar results as compared with other methods.³ Although tissue biopsy should be performed when possible, the following discussion focuses on collection of swabs, as this is the most common approach. Important concepts for wound sampling are presented in ***Important Considerations when Collecting a Specimen from a Wound***.

Flocked swabs should be used when available, as they recover bacteria from infected sites as well as cotton- or rayon-tipped swabs but are more effective at releasing recovered bacteria into the culture medium.⁴

A properly collected swab often appears relatively clean, with only some blood-tinged fluid present (*Figure*).

Of note, fungal culture can be considered in any case, but fungal infections are uncommon. Fungal culture is more

important in infections that do not respond as expected to antimicrobials, in infections with unusual clinical presentation or progression, or when cytology suggests fungal involvement.

Sample Handling

Loss of viability (ie, false negatives) and contamination (ie, false positives) are of concern. Swabs for culture should be placed in an appropriate transport medium. Most commercial culture swab sets are effective at preserving viability of aerobic bacteria for the time typically required for a sample to reach the diagnostic laboratory. Anaerobes are more prone to death during transit, and either anaerobic transport media or combined aerobic/anaerobic transport media should be used if anaerobic culture is to be performed.

Swabs should be stored at room temperature if they will be processed by the laboratory within 2 hours. However, this will be difficult in most clinical situations; when delays will be encountered, swabs should be stored at refrigeration temperature (39°F [4°C]) until shipping and kept cool during shipping. Slides for cytology should be prepared immediately after collection. Ideally, the

IMPORTANT CONSIDERATIONS WHEN COLLECTING A SPECIMEN FROM A WOUND⁵

- ▶ Sampling of the uncleaned surface of a wound is not recommended.
- ▶ A specimen (eg, a swab or biopsy of clean but infected tissue), rather than a sample of a specimen (eg, pus), should be collected.
- ▶ Healthy tissue—not necrotic tissue or pus—from the affected area should be sampled.
- ▶ When possible, specimens should be collected prior to starting antibiotics.
- ▶ Poor-quality specimens (eg, necrotic tissue, superficial swabs of pus) should not be submitted to the laboratory, as misleading information can be more harmful than no information.
- ▶ Specimens should be labeled properly with the body site from which the specimen was collected. Only indicating “wound” is not adequate.

same swab should not be used for both cytology and culture, as contamination could occur while the swab is being rolled on a slide and preparing the cytology slide will remove some of the bacterial biomass.

Interpretation of Culture Results

Despite the use of optimal techniques, sampling will never be 100% sensitive and specific, and laboratory error (both technical error and abnormal behavior of bacteria in vitro) can occur. Any culture result must be carefully interpreted, with consideration of the body site, common pathogens, sample type, and the organisms that were isolated. Mixed infections can occur but are probably uncommon. Isolation of multiple organisms should be approached with caution, as one (or all) could be a contaminant. Although many commensals are opportunistic pathogens, isolation of bacteria that are common members of the commensal microbiota and typically of limited virulence (eg, coagulase-negative staphylococci, enterococci) is typically not clinically relevant.

When determining whether an isolated bacterium is likely clinically important, antimicrobial resistance is irrelevant. Resistance and virulence are different, and a multidrug-resistant bacterium is not more likely to be clinically relevant than a susceptible counterpart. Therefore, the bacterial species, infection site, and degree of bacterial growth—not the susceptibility pattern—should be considered.

WHAT YOU WILL NEED

- ▶ Sterile saline
- ▶ Large syringe
- ▶ Gauze
- ▶ Gloves and, for some cases, a barrier gown
- ▶ Culture swabs, ideally flocked swabs
- ▶ Culture transport medium
- ▶ Glass slides
- ▶ Small surgical pack (optional)

STEP-BY-STEP COLLECTION OF WOUND CULTURE SWABS

STEP 1

Assemble all required supplies. Determine the degree of physical or chemical restraint that is necessary for proper sample collection.

STEP 2

Irrigate the wound with sterile saline (A). Debride any existing necrotic tissue. Then, using gauze, remove excess saline from the site (B), leaving a clean wound bed devoid of pus, debris, or necrotic tissue for sampling (C). If possible, let the site dry for ≈1 minute.



STEP 3

Replace gloves if they are contaminated and/or wet. Remove a sterile swab from its packaging, taking care not to contaminate it via contact with other surfaces. Rub the swab back and forth over $\approx 1 \text{ cm}^3$ of viable tissue in the affected area for ≈ 5 seconds, taking care to avoid contact of the swab with sites that have a commensal microbiota (eg, skin and mucous membranes). Apply pressure to the swab to help express fluid from the wound bed.

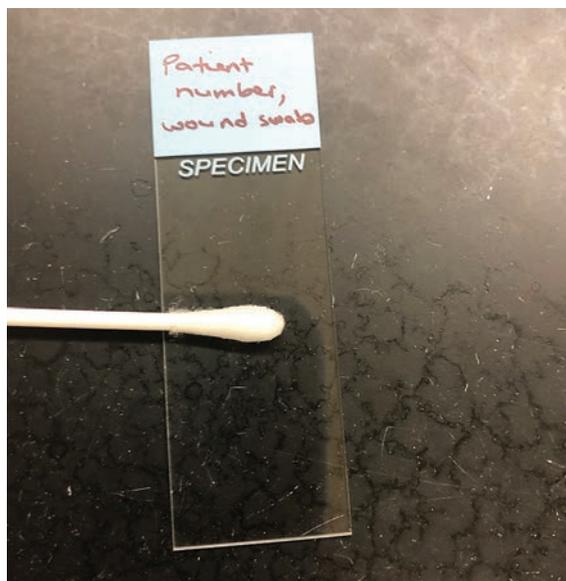


STEP 4

For culture specimens, place the swab into a transport medium and label the tube. Keep the swab at room temperature if it will be processed within 2 hours; otherwise, refrigerate the swab. Complete the laboratory submission form; include the specific sample location.

STEP 5

For cytology, roll a second swab onto a glass slide. Label the slide and allow it to air dry.



STEP 6

Indicate the swab site, disease process, species (along with any other relevant information), and patient history of antimicrobial therapy on the laboratory submission form. ■■■

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Hypocalcemia

Julie Allen, BVMS, MS, MRCVS, DACVIM (SAIM), DACVP

FOR MORE

Find more Differential Diagnosis lists in upcoming issues of *Clinician's Brief* and on cliniciansbrief.com

- ▶ Anemia
- ▶ Basophilia
- ▶ Decreased Total Thyroxine
- ▶ Eosinophilia
- ▶ Epistaxis
- ▶ Erythrocytosis
- ▶ Hypercalcemia
- ▶ Hypercholesterolemia
- ▶ Hyperglobulinemia
- ▶ Hyperkalemia
- ▶ Hypoalbuminemia
- ▶ Hypocholesterolemia
- ▶ Hypoglycemia
- ▶ Hypokalemia
- ▶ Hypophosphatemia
- ▶ Increased & Decreased Blood Urea Nitrogen
- ▶ Increased & Decreased Creatinine
- ▶ Increased Total Thyroxine
- ▶ Lymphocytosis
- ▶ Lymphopenia
- ▶ Monocytosis
- ▶ Neutropenia
- ▶ Panting

Most (~99%) calcium in the body is stored in the bones. The remaining calcium is stored in extracellular fluid and is composed of 3 parts: protein-bound, complexed, and unbound/ionized (active form) calcium. As a result, protein concentrations can affect total calcium; however, formulas to correct for albumin concentration should not be used, as they are often inaccurate. Any decrease in total calcium should be rechecked and an ionized calcium test performed if calcium is still decreased.

Following are differential diagnoses for patients presented with hypocalcemia.

- ▶ Acute pancreatitis
- ▶ Acute tumor lysis syndrome
- ▶ Artfactual hypocalcemia
 - EDTA or citrate contamination of serum sample
- ▶ Critical illness (likely multifactorial), including sepsis
- ▶ Drug-induced effect
 - Bicarbonate infusion
 - Bisphosphonates
 - Enrofloxacin
 - Furosemide
 - Phosphate enema
 - Tetracyclines
- ▶ Eclampsia
- ▶ Ethylene glycol toxicity
- ▶ Hyperthyroidism
- ▶ Hypoalbuminemia (most common cause)
- ▶ Hypomagnesemia
- ▶ Massive blood transfusion (excessive citrate)

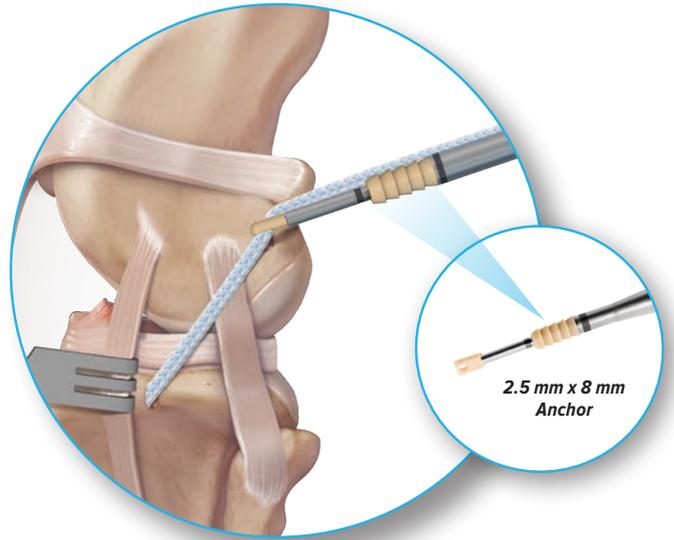
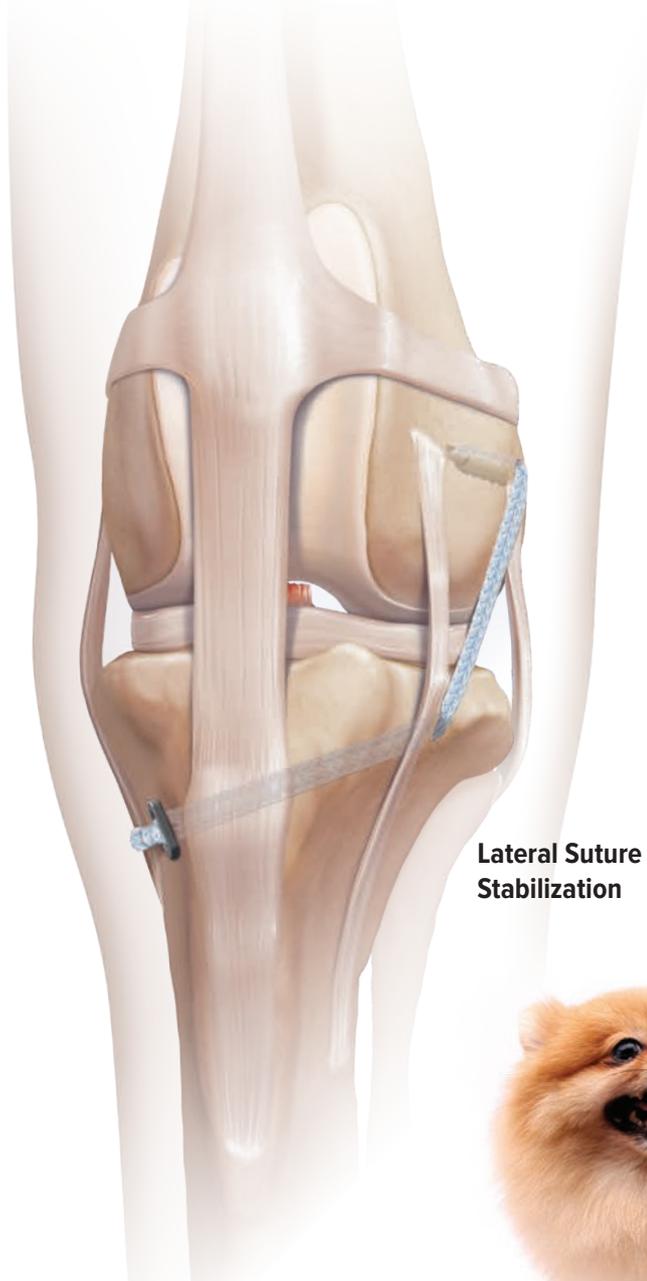
- ▶ Medullary thyroid carcinoma (increased calcitonin)
- ▶ Metabolic (eg, secondary to protracted vomiting) or respiratory (eg, hyperventilation) alkalosis
- ▶ Postsurgical correction of primary hyperparathyroidism or hyperthyroidism
- ▶ Primary hypoparathyroidism
- ▶ Protein-losing enteropathy
- ▶ Renal secondary hyperparathyroidism
 - Chronic or, less commonly, acute renal failure
- ▶ Secondary hyperparathyroidism due to nutritional (eg, vitamin D) deficiencies
- ▶ Severe rhabdomyolysis or soft tissue trauma
- ▶ Snake envenomation
- ▶ Urethral obstruction
- ▶ Vitamin D-resistant rickets (types I and II) ■

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1. Roca Hernandez R. Ex vivo mechanical properties of a 2.5 mm bone anchor for treatment of cranial cruciate ligament rupture in toy breed dogs [unpublished data]. 2020.



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Salivary Surgery

Dogs and cats have 4 major salivary glands: parotid, mandibular, zygomatic, and sublingual. The most common indication for salivary surgery is sialocele (salivary mucocele), which is an accumulation of saliva in the soft tissue resulting from leakage of saliva; the inciting cause can be trauma, sialoliths, or neoplasia but is typically unknown. The sublingual salivary gland complex is most often affected. With sialoceles, saliva typically migrates to the dependent tissues of the ventral neck and creates a fluctuant mass on the ipsilateral side. A sublingual sialocele (ie, ranula) is usually related to leakage of saliva that is rostral, resulting in saliva collecting under the tongue. Zygomatic and parotid sialoceles are uncommon.

Aspiration yields a clear viscous fluid that is consistent with saliva. Differential diagnoses include tumor, cyst, granuloma, or abscess. CT, fine-needle aspiration, or incisional biopsy may be necessary to rule out other conditions. For pharyngeal and sublingual sialoceles, surgical treatment involves marsupialization; surgical removal of the gland is recommended to prevent recurrence. A ventral approach should be used for sialoadenectomy of cervical, pharyngeal, or sublingual sialoceles. Sialoadenectomy of the parotid gland can be challenging; radiation therapy may be considered alternatively. Recurrence of sialocele is the most common complication of salivary gland surgery and can occur if salivary tissue remnants are left behind. Because salivary tissue is radiosensitive, radiation therapy may be useful in cases where sialocele returns.
—Amsellem P

Mistakes Made & Lessons Learned in Feline Orthopedic Examinations

Orthopedic disease is common in cats, with hip dysplasia reported in $\leq 32\%$ and osteoarthritis in 50% to 90% of cats. In addition, systemic disease (eg, neoplasia, heart disease) can cause lameness or muscle weakness, which decreases a cat's ability to compensate for orthopedic disease.

Cats with orthopedic disease are typically presented with poor grooming, urination or defecation changes, and/or behavior changes. Examination can be difficult because cats typically are not leash trained, may not cooperate, are not food motivated, and may freeze when frightened. Examination rooms should be safe and large enough for cats to move without being able to hide. It

is recommended that cats be allowed to explore the room and observations made on if they are willing to jump on/off counters or chairs. Allowing cats to return to the carrier can be helpful in observing movement. Signs to watch for include tail shifts, asymmetry in muscle weight bearing, or abnormal joint angles. Video of the cat's gait can be recorded at the examination or at home by the pet owner.

The joints, spine, and limbs should be palpated during standing examination. The joints, head, and tail should be moved through a range of motion, and postural reactions (eg, knuckling, hopping, visual and tactile placing, extensor postural thrust) should be evaluated; however, the response may vary among cats. An Ortolani test, a cranial drawer test, hip extension and abduction, palpation of the axillary region, and examination of the claws should be done during lateral examination. Sedation can be used to help differentiate stress from a pain response.—Gordon-Evans W

The Back Dog: When to Refer & When to Manage

The level of neurologic deficits in dogs presented with back pain or pelvic limb deficits can affect the treatment plan and prognosis; therefore, the initial critical assessment should be of the dog's ability to ambulate on a nonslip ground surface. In paraplegic dogs, superficial pain perception should be tested in the tail and pelvic limbs; if these pain perceptions are absent, deep pain should be tested; limb withdrawal and tail wagging

can be reflexive and may not indicate pain sensation. Behavior responses positive for pain include head turning, crying, and licking; physiologic responses include elevated heart and respiratory rates and pupil dilation. In dogs with clinical signs of acute disc extrusion, radiography and blood tests are unlikely to affect treatment decisions.

Nonsurgical treatment—most importantly, strict cage rest—is appropriate for ambulatory dogs that have focal spinal pain or mild neurologic deficits or when surgical treatment is not an option. Analgesia is not a substitute for activity restriction, and there are no data supporting improved outcome

with any specific drug. Medications that can be considered include gabapentin, NSAIDs or steroids, and opioids. Even dogs with nonambulatory paraparesis may have a good prognosis with medical management.

Surgical treatment is indicated for dogs that are refractory to medical management and those with more severe neurologic deficits or recurring episodes. Severe neurologic deficits or rapid progression of clinical signs are indications that prompt surgical intervention is needed. Prognosis following surgery is generally good in all dogs except those with presurgical loss of deep pain.

—Thomas W

Diagnosis & Management of Digital Injuries

In sporting dogs, digital sprains and strains (typically affecting collateral ligaments and flexor tendons) and digital fractures are a common cause of lameness and more commonly affect the thoracic limbs. Although osteoarthritis in the digit occurs less commonly than sprains and strains, it may also be a cause of lameness or an incidental finding. In greyhounds, the most common sprain location is the proximal interphalangeal joint. Injury to the digits is also common in agility dogs; however, fractures are more common than sprains and strains.

Collateral ligament injuries typically result in medial or lateral joint swelling unless the injury is unstable, causing whole joint swelling. Acutely, medial to

lateral movements can be more painful than flexion and extension. Radiography findings include soft tissue swelling and potential bony fragments if ligament avulsion from the phalanx has occurred. For dorsopalmar radiographs, digits should be pulled into extension to avoid superimposition. Ultrasonography with a high-frequency probe and standoff pad can also be used to help assess collateral ligaments. Ultrasonography and radiography may be less useful for flexor tendon injuries, which can be identified through palpation along the flexor surface of the digit and identification of pain with digital flexion and extension; abnormal digit extension is pathognomonic for some grade 2 and 3 strains.

Although surgery for collateral and flexor

ligament injuries has been described, conservative management may also be successful in the treatment of these injuries. Buddy taping can provide joint stabilization and decrease some of the comorbidities associated with complete immobilization using casts and splints. In dogs, incorporating all digits (vs only the adjacent digit, as in humans) in the taping can create comfort and stability; slightly different taping methods are described depending on the type of injury. Taping is prescribed for 6 to 12 weeks, with the tape changed every 2 to 5 days. Osteoarthritis can be treated; intra-articular injections can be used to treat dogs that are refractory to more conservative treatments. Rehabilitation for digit injuries should be implemented immediately after injury occurs.—Brown J

Rehabilitation should be implemented immediately after injury occurs.

What's your vision for the future of your business?

3

Questions to ask as you enter discussions with potential partners.



NO. 01

Is it the right culture fit for your team?

As you begin considering your options for selling your pet hospital business, it's important to find a partner aligned with your values, respectful of the individuality of what you've built, and equipped to grow your business, while your team and culture remain intact.

Ask around to find out which buyers have the best reputation for caring for pets and the people who love them.

NO. 02

Are there flexible deal structures?

Because selling your pet hospital is such a personal decision, you'll want to understand what types of options are available, and to what level they can tailor the terms to meet your needs.

ASK IF THE BUYER CAN:

- Make 100% cash offers with no finance contingency
- Offer Joint Venture partnerships for growth and flexibility
- Buy the real estate outright or lease from you

NO. 03

How comprehensive are the support services?

As you contemplate transitioning your business, you'll want to know every aspect is covered. Seek out a partner with a dedicated team seasoned in marketing (including digital advertising and social media strategy), web development and hosting, client satisfaction surveys, IT, HR, accounting, taxes, legal, call centers and more.

NVA has over 800 partnerships in the US, Canada, Australia and New Zealand. Our passionate, visionary local pet resort and hospital leaders embody NVA's unique entrepreneurial spirit. Let's talk. You can reach us at: 888.767.7755 | NVA.com | info@NVA.com





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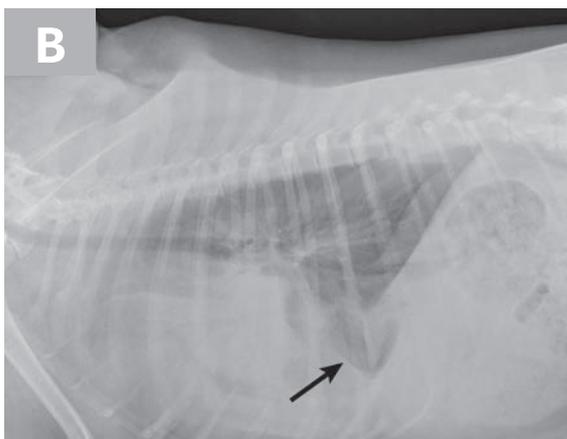
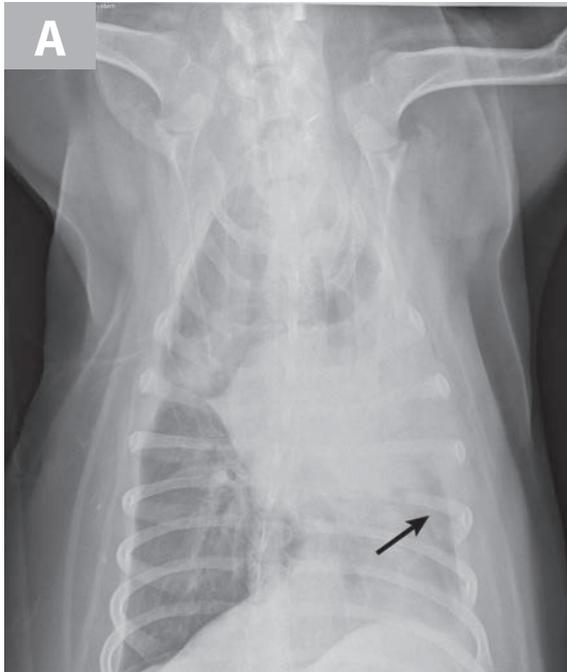
CASE IN POINT

ACUTE PLEURAL EFFUSION IN A DOG

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Lakeshore Veterinary Specialists
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Marcus, a 3-year-old, 77-lb (35-kg) neutered male golden retriever crossbreed, was presented for a 3-day history of increased respiratory effort. The owner noted Marcus had been wheezing when at rest but not coughing or gagging. He was current on vaccinations and flea and tick preventives and had no known trauma, foreign body ingestion, or tick or toxin exposure.



▲ **FIGURE 1** Right lateral (A) and ventrodorsal (B) thoracic radiographs obtained prior to thoracocentesis demonstrating a mild interstitial pattern, moderate pleural effusion, soft tissue opacity in the left cranial and middle lung field, border effacement of the heart, and a pleural fissure line (arrows)

LLT = lung lobe torsion

Physical Examination

On examination, Marcus was tachypneic with a respiratory rate of 60 bpm and a mild increase in expiratory effort. His heart rate was 144 bpm, mucous membranes were pink, and pulses were strong and synchronous. His temperature was mildly elevated at 103.2°F (39.6°C). On auscultation, heart and lung sounds were normal on the right side but decreased on the left. The remainder of the examination was unremarkable.

Diagnosis

Right lateral thoracic radiographs revealed a large amount of fluid/soft tissue opacity obscuring the cardiac silhouette. Ventrodorsal radiographs showed increased soft tissue opacity in the left hemithorax, primarily in the cranial and middle lung fields. A mild interstitial pattern, a pleural fissure line, and border effacement of the heart were noted in the left hemithorax (*Figure 1*).

Radiography findings suggested a combination of pulmonary and pleural space disease. Differential diagnoses included pleural effusion (eg, hemothorax, pyothorax, chylothorax, hydrothorax, neoplasia) and pleural space mass or mass effect (eg, neoplasia, lung lobe consolidation or torsion, abscess/granuloma).

CBC, serum chemistry profile, venous blood gas, urinalysis, and coagulation panel (prothrombin time, activated partial thromboplastin time) results were within normal limits.

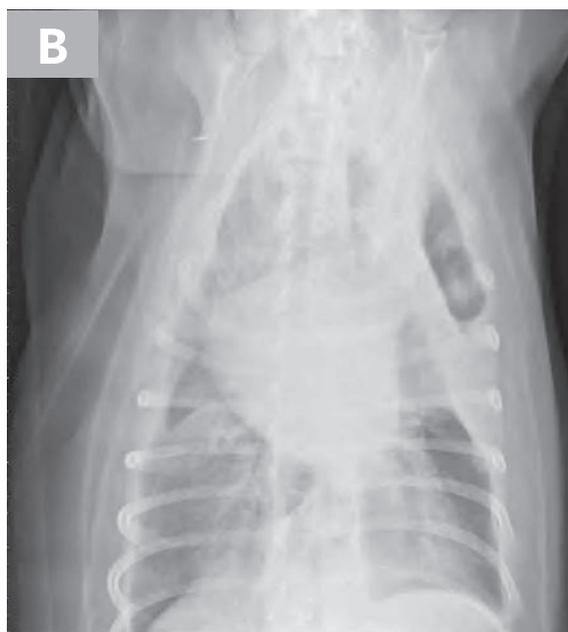
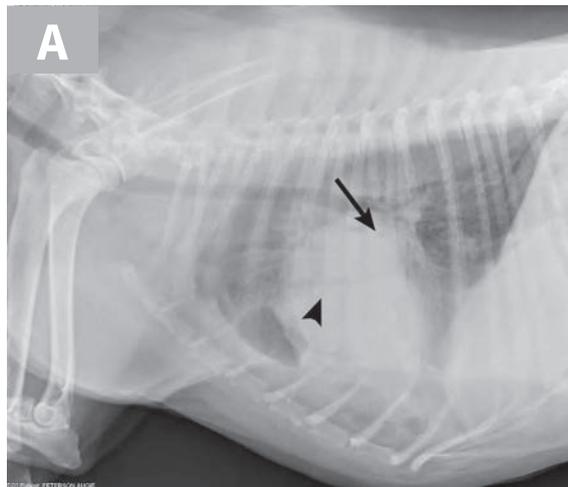
Pleural effusion was confirmed via thoracic ultrasonography, and therapeutic thoracocentesis was performed; 650 mL of serosanguinous fluid was removed from the left side (*Figure 2*) and 150 mL from the right side. Packed cell volume and total solids of the fluid were 4% and 3.5 g/dL, respectively, and cytology demonstrated a chronic hemorrhagic, neutrophilic, and histiocytic inflammatory exudate with mesothelial cell hyperplasia, suggesting inflammation without overt evidence of infection or neoplasia.

Radiographs obtained after thoracocentesis demonstrated improved pleural effusion and consolidation of the left middle lung lobe (**Figure 3**). Based on the soft tissue bulge near the hilum and the air bronchogram extending cranially, the primary differential was lung lobe torsion (LLT). Other considerations included pulmonary mass, abscess, or granuloma.

CT demonstrated bilateral moderate pleural effusion with an abnormal appearance of the left cranial lung lobe, stippled gas collections, and truncation of the bronchus that suggested LLT (**Figure 4**, next page).

Left lateral thoracotomy revealed LLT in the caudal portion of the left cranial lung lobe, and a lung lobectomy was performed. A 20 Fr thoracostomy tube and pleural catheter were placed for postoperative recovery, monitoring, and pain control

(**Figure 5**, page 27). Two days postoperation, the amount of pleural effusion aspirated from the thoracostomy tube was still significant in quantity (72 mL/kg/day) and off-white in color (**Figure 6**,



▲ **FIGURE 2** A sample of the serosanguinous fluid removed from the thoracic cavity with the initial centesis. This preoperative fluid is substantially different in appearance from the fluid collected postoperatively (**Figure 6**, page 27).

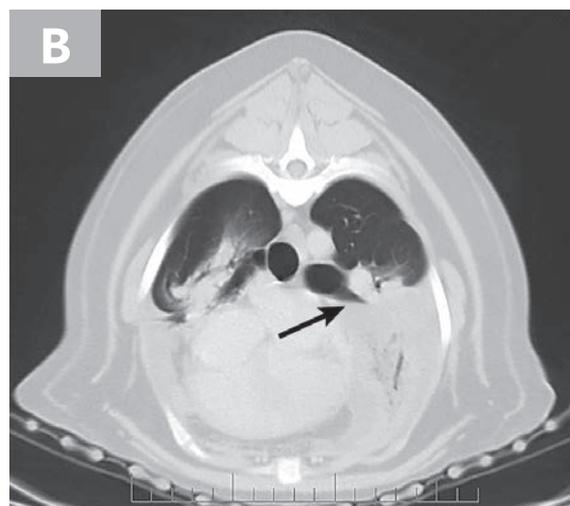
▲ **FIGURE 3** Right lateral (**A**) and ventrodorsal (**B**) thoracic radiographs obtained after thoracocentesis showing improvement in pleural effusion with a persistent soft tissue opacity in the left mid-to-cranial thorax. An air bronchogram is seen extending cranially from the hilum (**arrowhead**) where a subtle bulge (**arrow**) is present.

page 27). The fluid was confirmed to be chylous effusion based on cytologic examination results (ie, lipid droplets, moderate numbers of mature lymphocytes, and a few macrophages) and paired serum (95 mg/dL) and effusion (819 mg/dL) triglyceride levels.

TREATMENT AT A GLANCE

- ▶ Thoracocentesis should be performed when pleural effusion is present.
- ▶ Chylothorax should be investigated preoperatively if LLT is suspected prior to surgical intervention. Additional surgery at the time of lung lobectomy may be necessary.
- ▶ LLT is best treated with surgical removal of the affected lobe.
- ▶ Idiopathic chylothorax should be treated surgically for the best outcome; medical management has limited success.
- ▶ Refractory chylothorax cases may be managed with placement of a permanent indwelling pleural access catheter.

LLT = lung lobe torsion



▲ **FIGURE 4** Sagittal CT images of the thorax demonstrating pleural effusion, gas trapping in the left cranial lung lobe (**A**, **arrow**) and a truncated bronchus (**B**, **arrow**). Findings were consistent with left cranial LLT, secondary pulmonary consolidation, and fluid accumulation.

DIAGNOSIS: LUNG LOBE TORSION

Treatment & Management

Fluid continued to be produced in large quantities over the next week, with a plateau at >30 mL/kg/day. Treatment options discussed with the owner included medical management, placement of a long-term SC pleural port, and surgery. Surgery was elected, and pericardiectomy, thoracic duct ligation, and ablation of the cisterna chyli were performed.

Prognosis & Outcome

Marcus did well during the second surgical procedure; chylothorax resolved quickly, and he was discharged after 3 days. His condition was reported as normal 3 years after the procedure.

Discussion

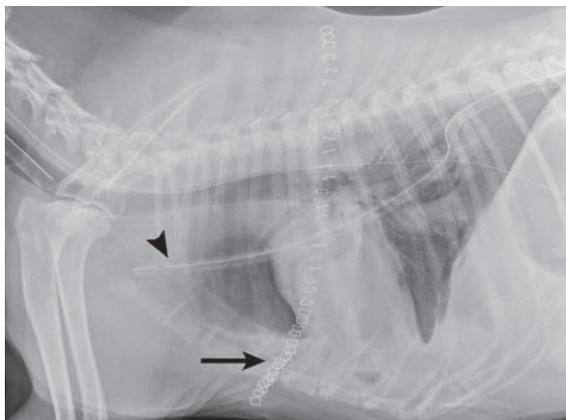
LLT can be idiopathic or secondary to pleural effusion, other pulmonary or pleural space disease, trauma, or thoracic surgery.^{1,2} Deep-chested, large-breed dogs (especially Afghan hounds) and certain small-breed dogs (eg, pugs) have been reported to

have a higher occurrence of LLT.¹⁻⁶ Lobectomy of the affected lung lobe is the treatment of choice for LLT. Previously, survival rates were 50% to 78%^{1,2,6}; however, more recent studies report a survival-to-discharge rate of 92%.⁴

Chylothorax can occur secondary to intrathoracic pathology that causes obstruction of the thoracic duct and normal lymph flow. Common causes include granuloma, trauma, congenital abnormalities of the thoracic duct, diaphragmatic hernia, cardiac disease, thoracic surgery, and intrathoracic neoplasia.^{7,8} Although the underlying cause of chylothorax should be treated, a primary cause (ie, idiopathic chylothorax) is not identified in many cases.⁷

Chylothorax is a common pre- and postoperative finding with LLT.^{1,2-5,9} Pleural effusion is thought to increase the risk for LLT, and chylothorax that develops after lung lobectomy may be caused by trauma to the thoracic duct during surgery or pleuritis from LLT, which alters lymphatic flow.^{1,2,9} When LLT is diagnosed and pleural effusion is present, presurgical serum and fluid triglycerides should be tested to diagnose chylous effusion, as chyle may not always have a milky appearance, and the presence of chylothorax may warrant additional surgical procedures at the time of lung lobectomy.⁵

Several therapeutic options are available for idiopathic chylothorax.¹⁰⁻¹⁶ Medical options include feeding a low-fat, medium-chain triglyceride diet and administering rutin (a benzopyrone) with or without octreotide (a somatostatin analog). Medical therapy alone has a low success rate (eg, 40%).¹⁰⁻¹² Surgical options include ligation of the thoracic duct, subtotal pericardiectomy, and cisterna chyli ablation. Success rates of 53% to 88% have been reported when these surgical procedures are used in combination.^{10,13-16} Other surgical procedures with variable success rates have also been reported, including thoracic omentalization, pleurodesis, placement of pleuroperitoneal or pleurovenous shunts, and placement of permanent pleural space catheters for intermittent evacuation of fluid.^{10,13-16}



▲ **FIGURE 5** Postoperative lateral thoracic radiograph showing staples (**arrow**) from the lateral thoracotomy and the thoracostomy tube (**arrowhead**) in the appropriate positions. Small amounts of pleural effusion are expected, but cardiac border effacement is no longer present.



▲ **FIGURE 6** Postoperative pleural effusion (**left**) and serum (**right**) showing the gross appearance of chylothorax. The pleural effusion is turbid and off-white in color, which is consistent with the milky appearance of chylous effusion. The serum appears normal.

Continues ►

TAKE-HOME MESSAGES

- ▶ LLT should be suspected in young patients presented with acute pleural effusion and possible lung consolidation but are otherwise healthy. Certain breeds may be predisposed to LLT.
- ▶ LLT is best diagnosed with CT or surgery. The index of suspicion is raised when focal soft tissue density in a lung lobe is seen on routine radiographs with or without pleural effusion. A stippled appearance of the lung field, indicating trapped air or truncated bronchus, may also be present.¹⁷
- ▶ When LLT is diagnosed and pleural effusion is present, serum and fluid triglycerides should be compared preoperatively to determine the presence of chyle.
- ▶ Chylothorax is diagnosed when fluid triglycerides are ≥ 2 times higher than serum triglycerides in a fasted patient. Cytologic findings can help confirm the diagnosis.
- ▶ If the underlying cause of chylothorax is undetermined or untreatable, medical management may be attempted but typically has limited success. Surgical options have improved, but outcomes are variable.

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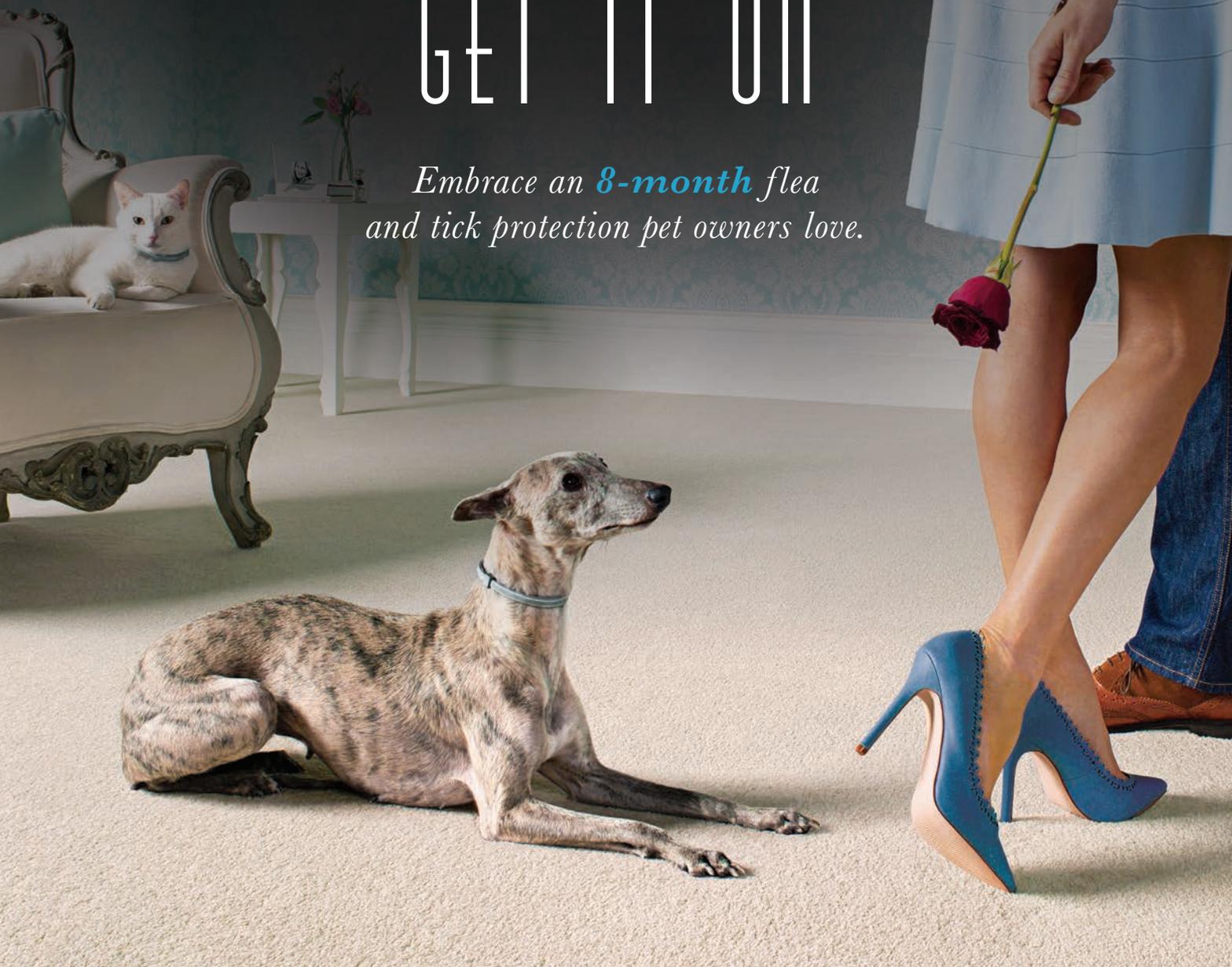
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LLT = lung lobe torsion

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Effusion Cytology

Maxey L. Wellman, DVM, MS, PhD, DACVP (Clinical Pathology)

M. Judith Radin, DVM, PhD, DACVP (Clinical Pathology)

The Ohio State University

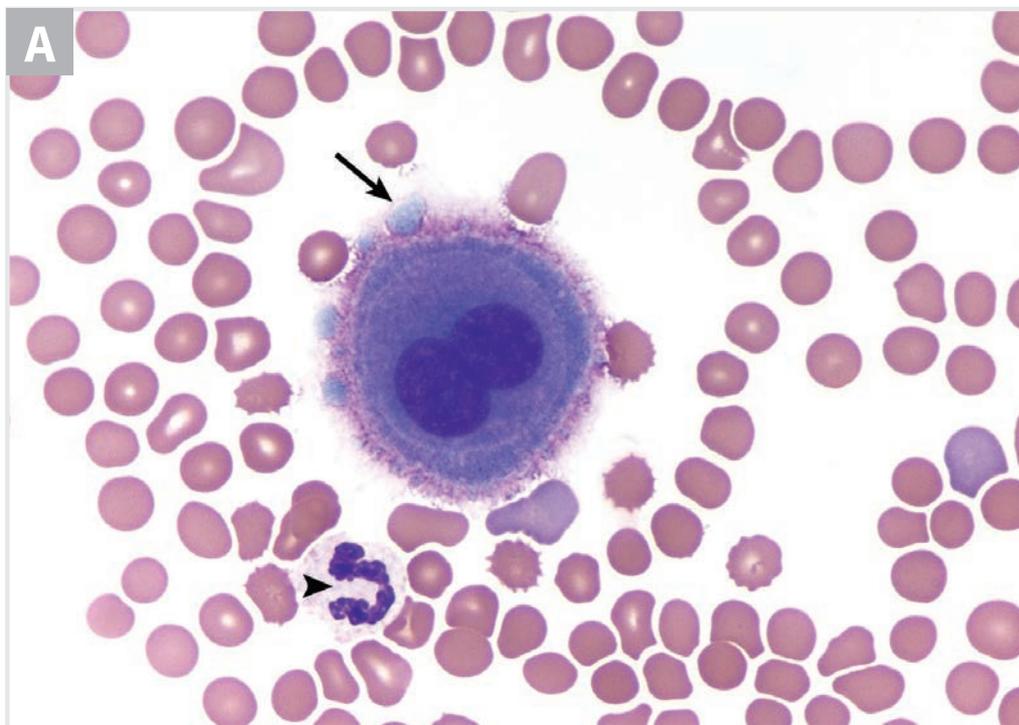
Effusions result from increased hydrostatic pressure or vascular permeability, altered oncotic pressure, or impaired lymphatic drainage. Effusions into body cavities (eg, thorax, abdomen, pericardial sac) are most commonly associated with inflammation, neoplasia, hemorrhage, trauma, obstruction, or leakage from the urinary or biliary tracts. Effusion cytology is relatively noninvasive and inexpensive and often provides an accurate diagnosis or contributes to diagnostic planning and prognosis.

Clinical history and physical examination findings are helpful in establishing differential diagnoses. For example, a young cat with weight loss and hyperproteinemia is more likely to have an inflammatory effusion from FIP than from a neoplastic process. Likewise, an older large-breed dog with acute collapse and a large splenic mass is more likely to have hemorrhagic effusion from a

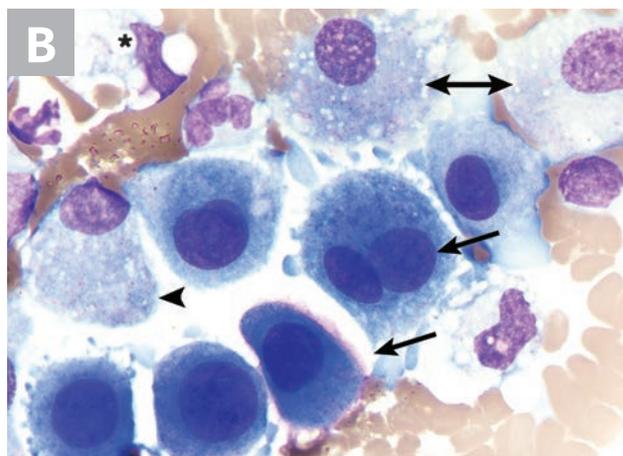
ruptured hemangiosarcoma than from a transudate associated with hyperadrenocorticism.

Typically, only several milliliters of fluid are present in the thorax, abdomen, and pericardial sac in dogs and cats. The fluid is clear, colorless, and minimally cellular ($<3 \times 10^9$ cells/L) with a relatively low total protein concentration (<2.5 g/dL).¹ There is some variability in classifying effusions, and several schemes and algorithms are presented in the literature.^{1,2} Recent classification schemes have simplified effusion categories into low-protein transudates (<2.5 g protein/dL and $<3 \times 10^9$ nucleated cells/L), high-protein transudates (≥ 2.5 g protein/dL and $<3 \times 10^9$ nucleated cells/L), and exudates (≥ 2.5 g protein/dL and $\geq 3 \times 10^9$ nucleated cells/L).¹ A hemorrhagic effusion is suggested if the fluid packed cell volume is $\geq 25\%$ that of the peripheral blood or if $>0.5 \times 10^{12}$ RBCs/L are present.^{1,3} Neoplastic processes can be associated with any fluid type, emphasizing the importance of microscopic evaluation.

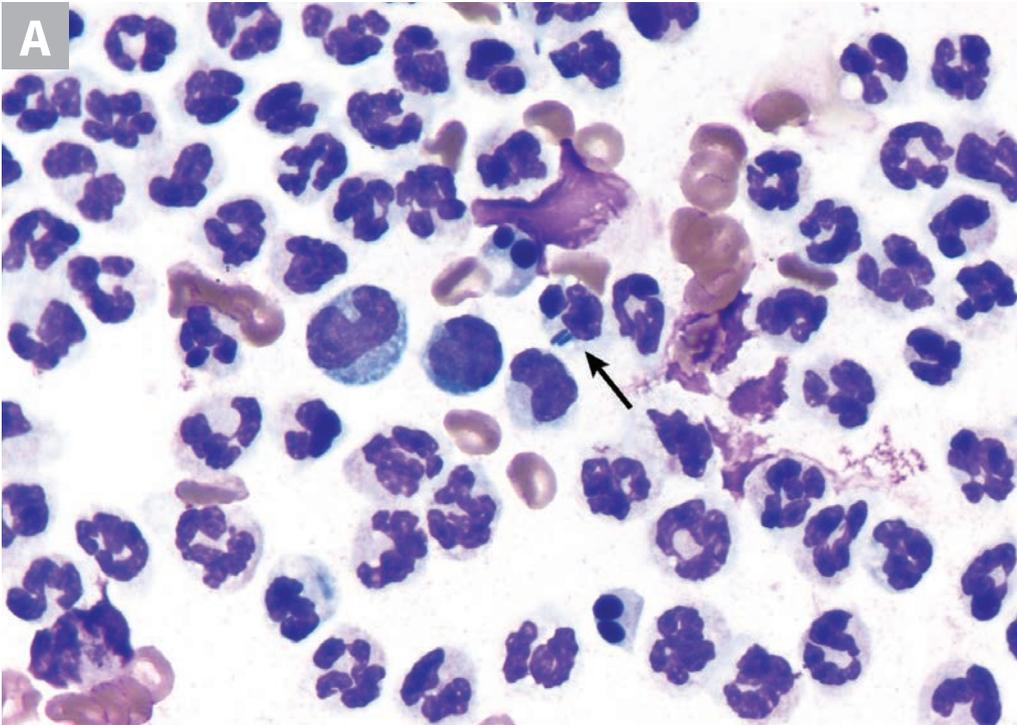
Examples of the types of cells that occur in effusions are included in this image gallery.



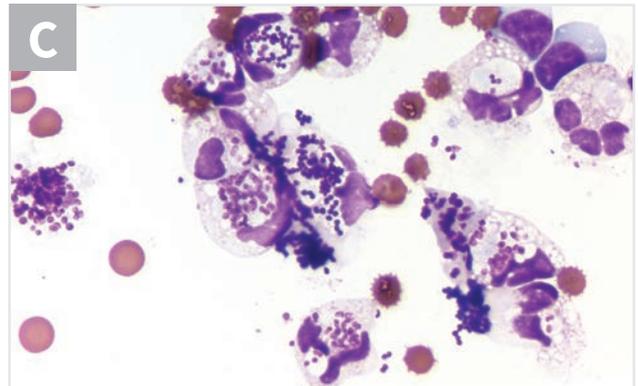
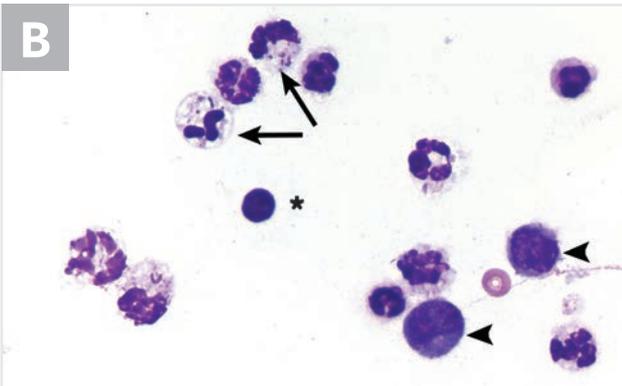
▶ **FIGURE 1** Mesothelial cells. Thoracic fluid from a dog (A). Body cavities are lined by mesothelial cells, which are present in variable numbers in most effusions. Mesothelial cells (**arrow**) are much larger than neutrophils (**arrowhead**) and are characterized by abundant basophilic cytoplasm that often has an eosinophilic fringe border or corona. The cytoplasmic blebs seen along the upper left border of the cell (**tip of arrow**) likely are an artifact. Round, central nuclei have stippled chromatin and may have visible nucleoli. Binucleated cells are not uncommon. *Wright-Giemsa stain; magnification 1000×*



Pericardial fluid from a dog (B). Several large reactive mesothelial cells with deeply basophilic cytoplasm are apparent in the center (**arrows**). Reactive mesothelial cells occur with inflammation or fluid accumulation from other causes and are characterized by increased variation in cell size, nuclear size, and nuclear:cytoplasmic ratio, as well as increased numbers of binucleated and multinucleated cells. These features are common in pericardial fluid from varying causes and are similar to those of neoplastic epithelial cells, which may be difficult to differentiate from reactive mesothelial cells based only on morphology. In addition, there are several macrophages with foamy cytoplasm (**arrowhead** and **double-sided arrow**), one with erythrophagocytosis (**asterisk**), and several neutrophils, likely from blood contamination. *Wright-Giemsa stain; magnification 1000×*



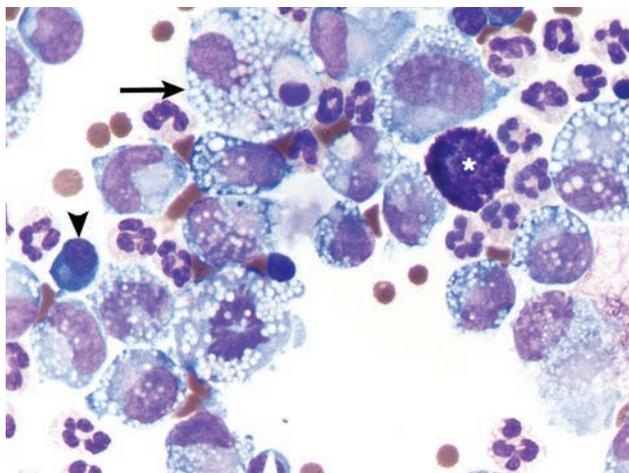
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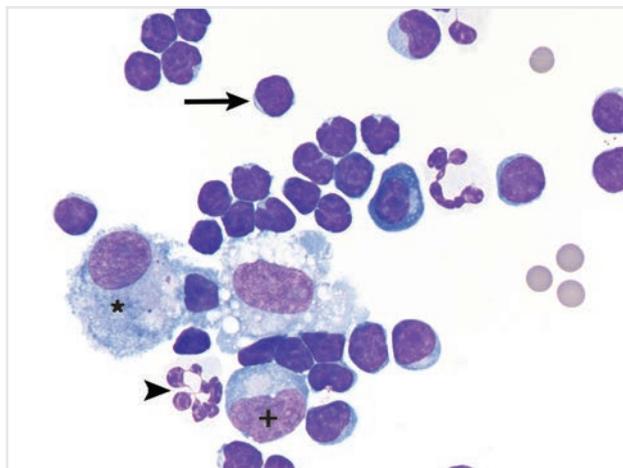
▲ **FIGURE 2** Neutrophilic inflammation. Thoracic fluid from a dog (A). Neutrophils may be present in many types of effusions, including transudates, and are useful for size comparison with other cells. Increased numbers of neutrophils occur with inflammation, which can be septic or nonseptic. Nondegenerate neutrophils, as shown here, have distinct nuclear borders and tightly clumped chromatin. Although the neutrophils appear nondegenerate in this effusion, 2 large, dark blue bacterial rods may be seen in one neutrophil (**arrow**). It is more typical for neutrophils to appear degenerate with bacterial infection, as shown in **Figure B**. The absence of bacteria on cytology does not preclude the presence of infection, as cytology is not as sensitive as culture. *Wright-Giemsa stain; magnification 1000×*

Abdominal fluid from a dog (B). Degenerate neutrophils often occur with bacterial infection and are characterized by swollen nuclei with less-condensed chromatin and vacuolated cytoplasm. Two neutrophils are present with intracellular bacterial rods and cocci (**arrows**). A small lymphocyte (**asterisk**) and 2 large mononuclear cells (**arrowheads**) are present. *Wright-Giemsa stain; magnification 1000×*

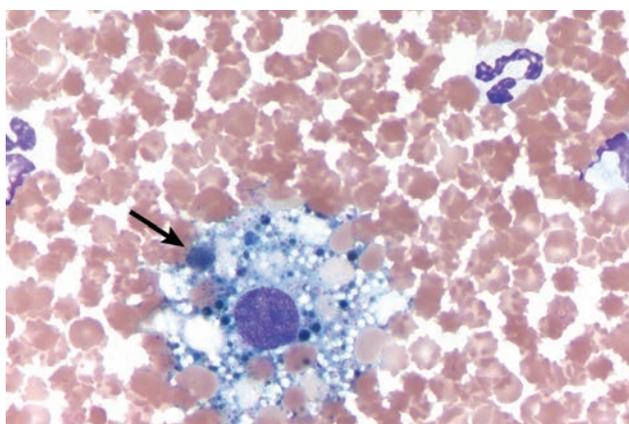
Abdominal fluid from a dog (C). Bacteria typically stain dark blue with Romanowsky stains, as seen in **Figure A**. Most of the neutrophils in this image are severely degenerate and contain numerous large cocci. In some of the neutrophils, the cocci stain dark purple, whereas in others, the cocci appear swollen with lighter staining, likely from being metabolized in the neutrophil phagolysosome. *Wright-Giemsa stain; magnification 1000×*



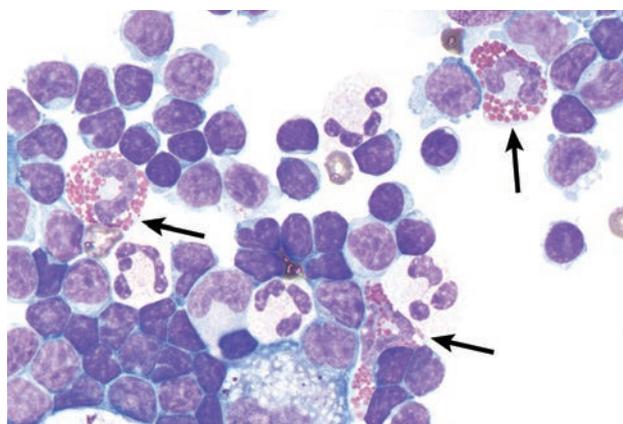
▲ **FIGURE 3** Abdominal fluid from a dog with chronic chylous effusion showing mixed inflammation. Macrophages are large, mononuclear cells that often have round, oval, or bean-shaped nuclei and abundant vacuolated cytoplasm. The vacuoles in this case likely are from imbibed lipid. Cytophagocytosis (**arrow**) is not uncommon, especially with inflammation, as shown in this mixed inflammatory effusion. A plasma cell, characterized by deeply basophilic cytoplasm with a perinuclear clear area and an eccentric round nucleus with condensed chromatin (**arrowhead**), can be seen. Plasma cells may be an indication of chronicity. A mast cell, characterized by numerous dark purple granules that obscure the nucleus, is also shown (**asterisk**). Mast cells can be part of the inflammatory response. *Wright-Giemsa stain; magnification 1000×*



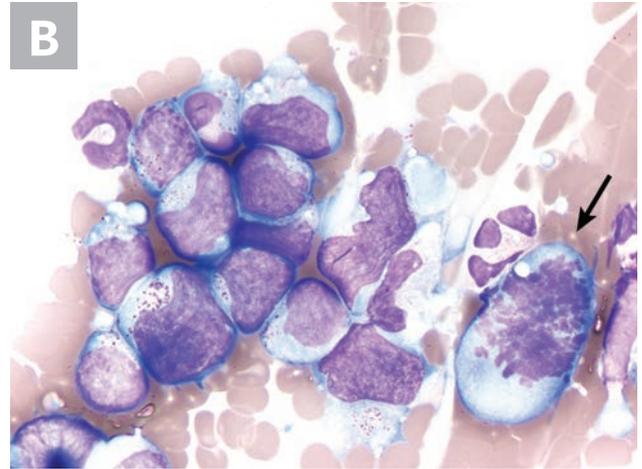
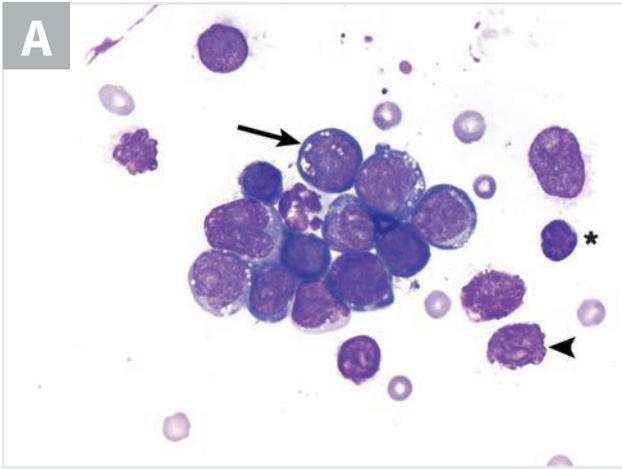
▲ **FIGURE 5** Thoracic fluid from a cat with chylous effusion. Numerous small lymphocytes (**arrow**), 3 neutrophils (**arrowhead**), 1 large mononuclear cell (**plus sign**), and 2 macrophages characterized by vacuolated cytoplasm (**asterisk**) can be seen. The small vacuoles are typical of phagocytosis of lipid in chylous effusions. The lymphocytes are smaller than the neutrophils, have round to slightly indented nuclei with condensed chromatin, and have a very high nuclear:cytoplasmic ratio, which is consistent with the well-differentiated lymphocytes typical of chylous effusion. This fluid appeared cloudy and white before and after centrifugation. A fluid triglyceride concentration of >100 mg/dL supports a diagnosis of chylous effusion.⁴ *Wright-Giemsa stain; magnification 1000×*



▲ **FIGURE 4** Thoracic fluid from a dog with hemorrhagic effusion. RBCs can be present from blood contamination related to sample collection or from hemorrhage. With hemorrhage, macrophages phagocytize RBCs and metabolize hemoglobin to hemosiderin, which appears as a dark blue to greenish-black pigment in the cytoplasm of this macrophage (**arrow**). Erythrophagocytosis can occur with delayed sample processing, but hemosiderin would not be present. *Wright-Giemsa stain; magnification 1000×*

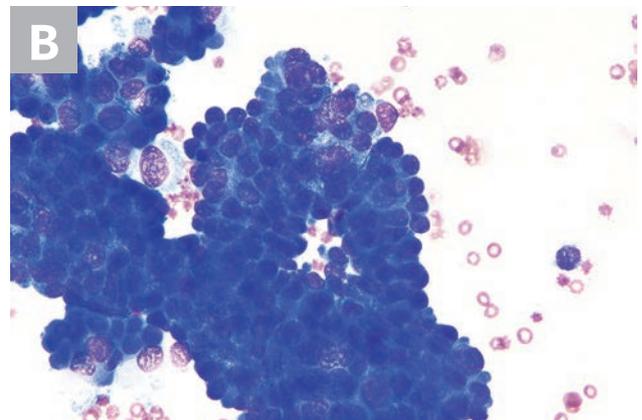
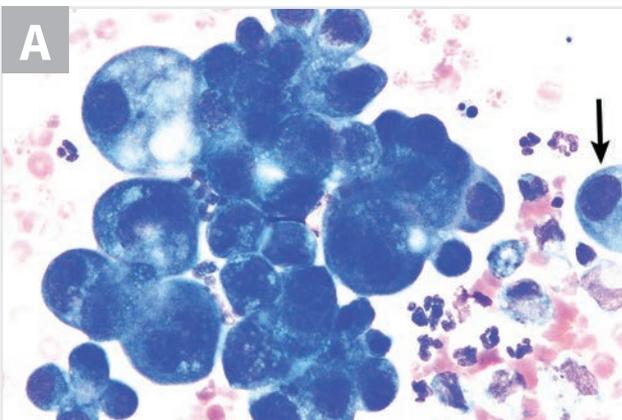


▲ **FIGURE 6** Thoracic fluid from a dog showing eosinophils. The distribution and morphology of the cells in this chylous effusion are similar to those in **Figure 5**, except there are 3 eosinophils (**arrows**). The presence of eosinophils can be relatively nonspecific, and numbers can be variable. They can occur as part of an idiopathic hyper-eosinophilic syndrome or with parasites; allergic, hypersensitivity, or foreign body reactions; inflammation; neoplasia (mast cell tumor or lymphoma); heart failure; or protein-losing enteropathy. *Wright-Giemsa stain; magnification 1000×*



▲ **FIGURE 7** Thoracic effusion in a cat with lymphoma (A). Most of the lymphocytes are larger than the neutrophil in the center. These large lymphocytes (**arrow**) have moderate amounts of basophilic cytoplasm and large, round to slightly irregular nuclei with fine chromatin and 1-2 prominent nucleoli and are consistent with a diagnosis of lymphoma. The small vacuoles in the neoplastic lymphocytes most likely resulted from the fluid environment. Bare nuclei from broken cells (**arrowhead**) should not be evaluated because they may be misinterpreted as neoplastic lymphocytes. A normal small lymphocyte (**asterisk**) appears smaller than the neoplastic lymphocytes. *Wright-Giemsa stain; magnification 1000×*

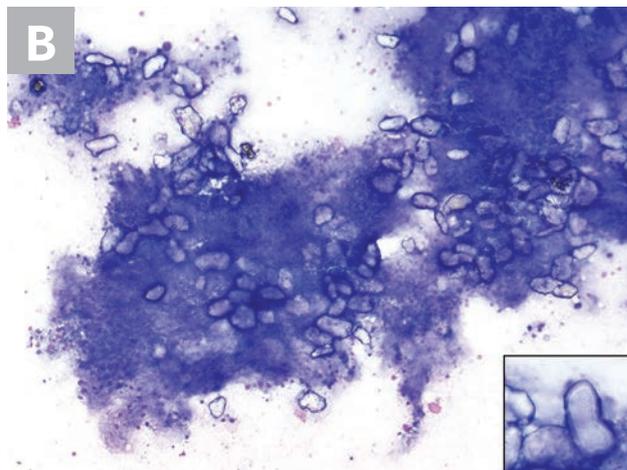
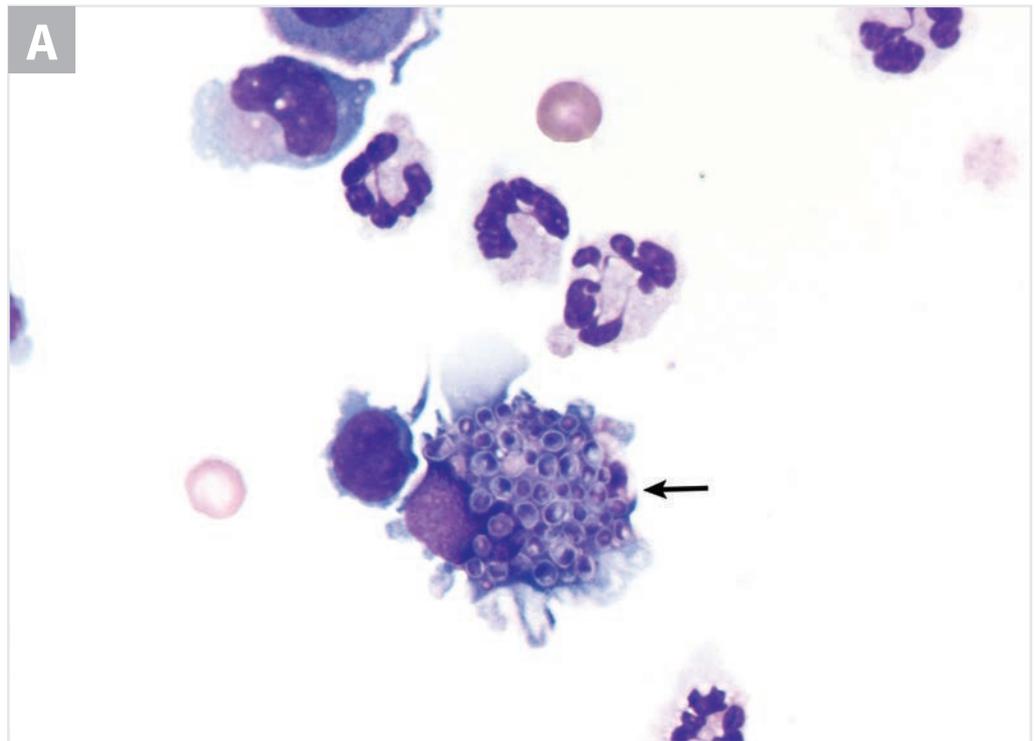
Abdominal fluid from a dog with lymphoma (B). Most of the cells are large lymphocytes with moderate amounts of lightly basophilic cytoplasm that often contains foamy areas with magenta granules. Nuclei are round to irregular-shaped and have smooth chromatin and indistinct nucleoli. These cells are consistent with a neoplastic proliferation of large granular lymphocytes, which are cytotoxic T lymphocytes. There is also a mitotic figure (**arrow**). *Wright-Giemsa stain; magnification 1000×*



▲ **FIGURE 8** Thoracic effusion from a dog with carcinoma (A). These large clusters of cohesive, atypical cells exhibit marked anisocytosis and anisokaryosis. The chromatin is fine to granular, and there are prominent nucleoli (**arrow**). These cells are much larger as compared with the nondegenerate neutrophils and erythrocytes present in the background. *Wright-Giemsa stain; magnification 500×*

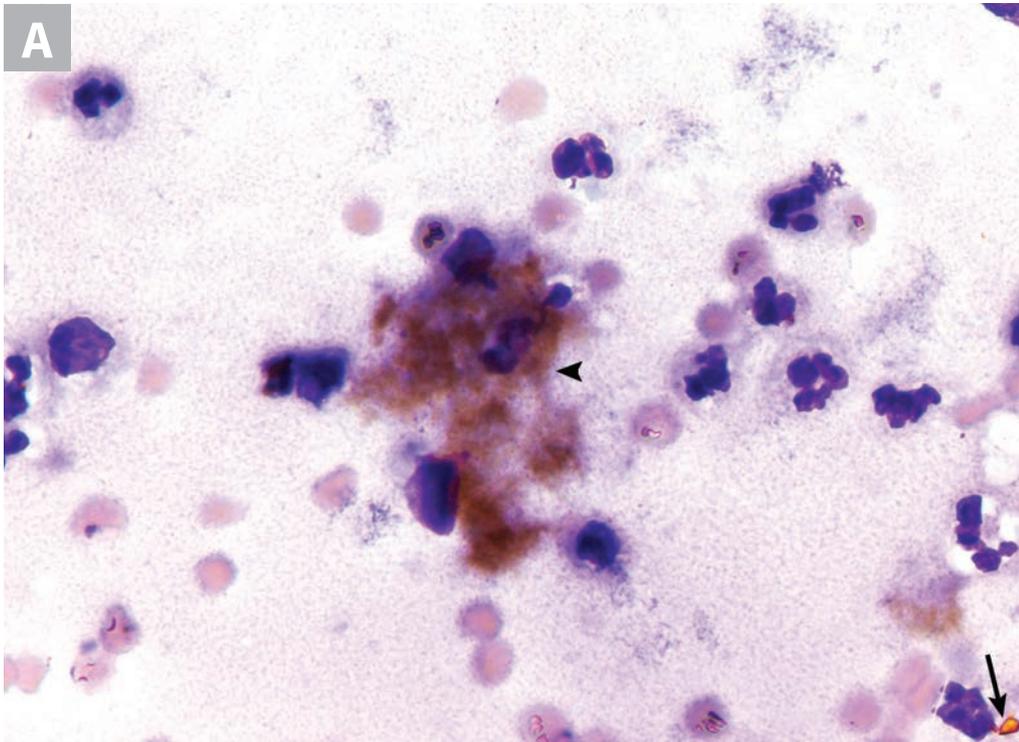
Thoracic fluid from a dog with mesothelioma (B). The large clusters have a frond- or papillary-like appearance. Anisocytosis and anisokaryosis are relatively mild in this case; however, some mesotheliomas can exhibit marked atypia. The chromatin is stippled to coarse, and prominent nucleoli may be present but are not apparent at this magnification. Neoplastic effusions can be highly cellular due to shedding of neoplastic cells into the effusion or from an accompanying inflammatory response. It can be difficult to distinguish carcinoma from highly reactive mesothelial cells or mesothelioma based on cytology. A biopsy is often needed for confirmation, along with special staining. *Wright-Giemsa stain; magnification 500×*

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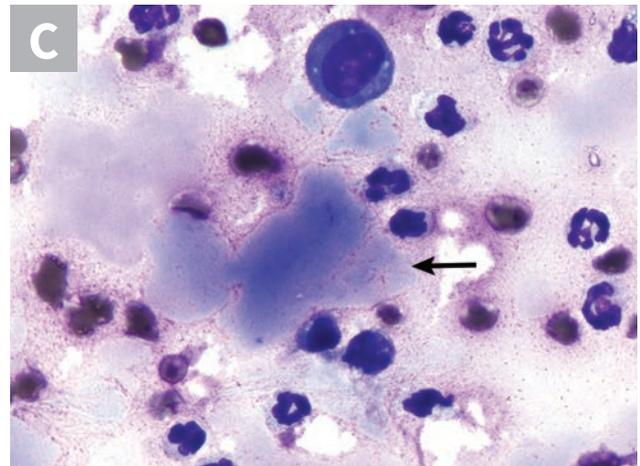
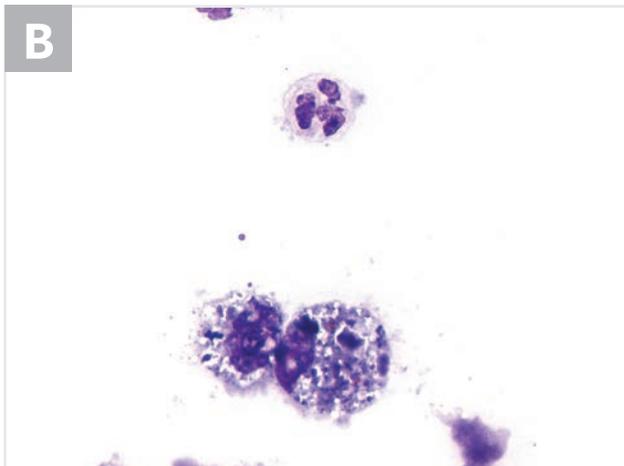


▲ **FIGURE 9** Infectious organisms. Abdominal fluid from a dog with histoplasmosis (**A**). The macrophage (**arrow**) contains numerous fungal organisms compatible with *Histoplasma capsulatum*. These organisms are 1 to 4 μm in diameter with a purple-staining nucleus and a clear, capsule-like rim. Five nondegenerate neutrophils, 1 small lymphocyte, and 1 large mononuclear cell are present. Fungal organisms can occasionally be observed in effusions as extensions of systemic disease (eg, *Histoplasma* spp, *Blastomyces* spp, *Coccidioides* spp, *Cryptococcus* spp infection) or from leakage of gut contents (eg, *Candida* spp infection). Wright-Giemsa stain; magnification 1000 \times

Abdominal fluid from a dog with peritoneal cestodiasis that contains cellular debris and calcareous corpuscles from the larvae of the *Mesocestoides* spp tapeworm (**B**). Calcareous corpuscles are 20 to 30 μm in diameter calcified granules that can be clear to light yellow. Wright-Giemsa stain, magnification 200 \times . A higher magnification (**inset**) shows the concentric rings that may be apparent in the calcareous corpuscles.



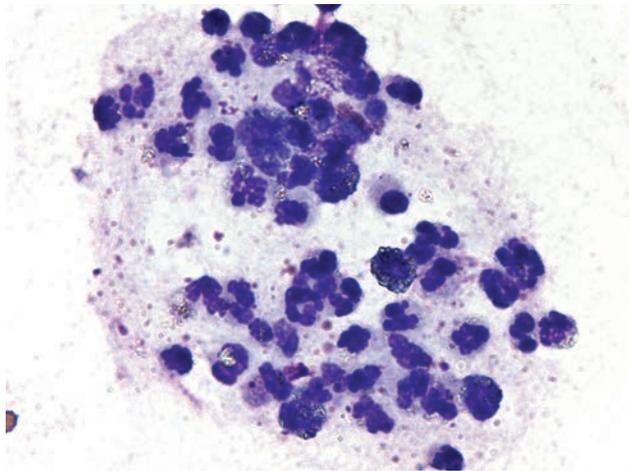
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▲ **FIGURE 10** Bile peritonitis. Abdominal fluid from a dog with bile peritonitis from a ruptured gallbladder (A). Many neutrophils are present, and there is a grainy, proteinaceous-appearing background. Extracellular, amorphous, orange/yellow bile pigment is present (**arrowhead**), and a bilirubin crystal is seen in the lower right corner (**arrow**). *Wright-Giemsa stain; magnification 1000×*

Abdominal fluid from a dog (B). When phagocytized by macrophages, bile pigment can appear blue or black in color and may be difficult to distinguish from hemosiderin. *Wright-Giemsa stain; magnification 1000×*

Abdominal fluid from a dog (C). In this case of white bile peritonitis, there is amorphous blue to pink extracellular material that lacks the typical yellow bile staining (**arrow**). Because bile is irritating, neutrophilic inflammation is apparent. In both typical bile peritonitis and white bile peritonitis, the abdominal fluid bilirubin concentration is often 2-fold greater than serum bilirubin,⁵ which may aid in diagnosis. *Wright-Giemsa stain; magnification 1000×*



▲ **FIGURE 11** Peritonitis with barium. There are many degenerate and nondegenerate neutrophils in a granular, proteinaceous-appearing background. Barium that leaked from the intestinal tract during a contrast study is apparent as clear to pale yellow, intracellular and extracellular crystalline material. Inflammation results from the irritating nature of the contrast material as well as from leakage of organisms from the intestinal tract. *Wright-Giemsa stain; magnification 1000×*

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See page 38 for product information summary.


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HEARTWORM EDUCATION



CHRIS DUKE, DVM

PRESIDENT, AHS
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Hit the “Reset” Button on your Client Education Program

It's spring—the season when many clients come to your clinic for heartworm checks, medication refills and their annual dose of heartworm education. As you think through how to once again make a compelling case for heartworm prevention, consider the following:

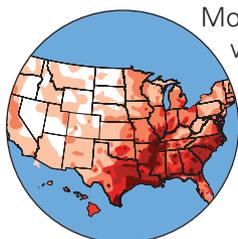
1. Clients learn best when there is a perceived need.



Pet owners must see a payoff if they're going to make the effort to learn about heartworms. I emphasize that heartworm disease is preventable and position preventives as “insurance policies” against it. Using a life cycle diagram, I explain that heartworms undergo three life stages inside the pet and two stages within the mosquito vector—then show clients how heartworm preventives interrupt this cycle.

I admit that I'm often tempted to tell my clients everything I know about heartworms. However, I've learned it is better to limit my talking points to essential information and to save the “nice to know” scientific facts for clients who demonstrate genuine interest.

2. Use visuals to facilitate understanding.



Most clients learn better if I combine visuals with my heartworm talk. That's why I keep copies of the AHS heartworm incidence map in every exam room. Clients are always drawn to the color of our locale on the map and it helps them understand the implications for their pets. I've also had clients point to parts of the country where they didn't expect heartworms to be endemic and say, “Wow. I'm going to tell my friend Mary that she'd better be giving her pets heartworm prevention!”

Like thousands of other veterinary practices, my clinic leverages social media to educate clients. Facebook, the most popular platform, is a highly visual and shareable medium that is used by seven in 10 U.S. adults, with three-quarters of those adults visiting the site once a day. I recommend you ask the administrator of your social pages to like/follow organizations such as the American Heartworm Society, so they can see and share engaging posts with infographics, videos, fact sheets and slide shows dedicated to heartworm facts.

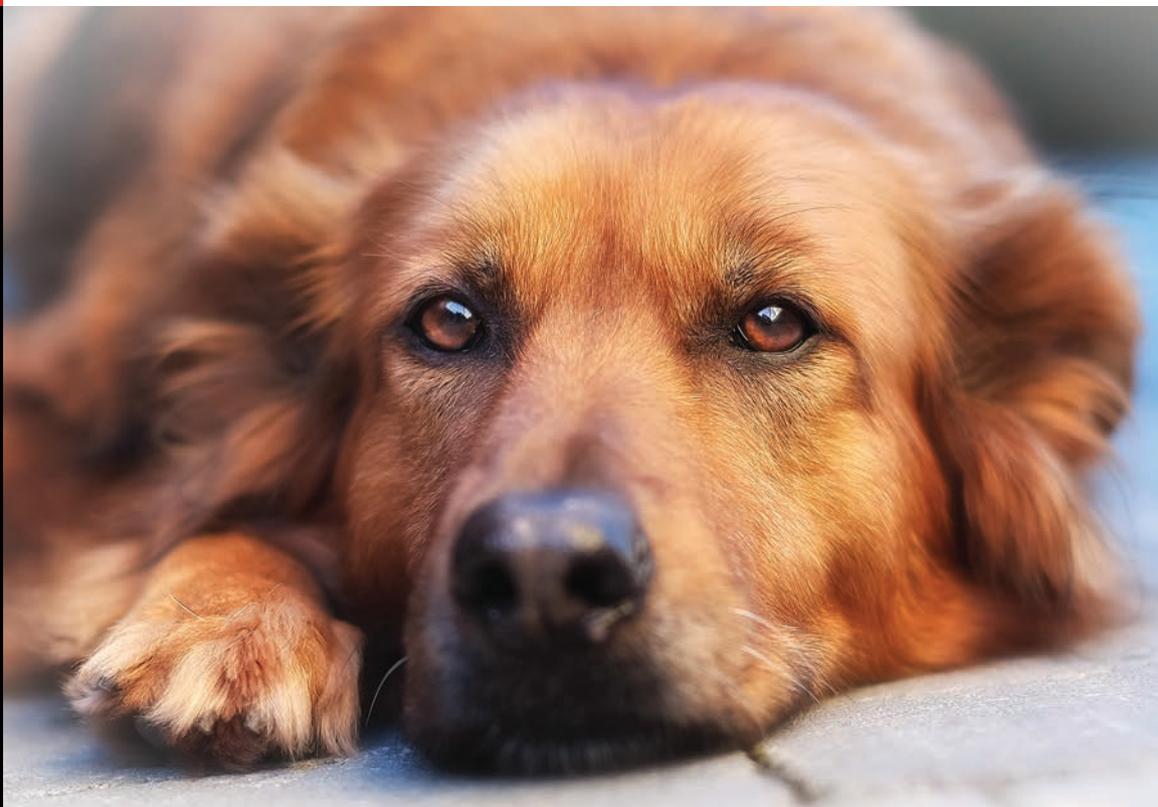
3. Building client trust and rapport pays off.



Clients who trust veterinarians and staff members are more willing to comply with our recommendations. I remind clients that, like them, I'm a busy pet owner who needs help remembering my own pets' heartworm preventives. Rather than lecture them about medication reminders, I pull out my phone and show clients the reminders I have set up to ensure I don't miss doses.

Trust is also critical if I'm to expect disclosure on the part of pet owners who have had lapses in preventive administration. With compliance as the ultimate goal, I can turn an honest admission of noncompliance into a teachable moment. Keeping my clinic a no-judgment zone can be critical to the health of my patients going forward.

Designed to bridge the gap between research pages and daily practice protocol, the following pearls offer tips and techniques to grow the general practitioner's clinical excellence.



42 Potential Adjuvant Treatment for Canine Ischemic Dermatopathy
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Potential Adjuvant Treatment for Canine Ischemic Dermatopathy

Paul Bloom, DVM, DACVD, DABVP (Canine & Feline)

Allergy, Skin and Ear Clinic for Pets

Livonia, Michigan

Michigan State University

In the Literature

Levy BJ, Linder KE, Oliverly T. The role of oclacitinib in the management of ischaemic dermatopathy in four dogs. *Vet Dermatol.* 2019;30(3):201-e63.

FROM THE PAGE ...

Ischemic dermatopathy is composed of a heterogeneous group of vasculopathic syndromes with indistinguishable clinical and histopathologic appearances. The underlying pathology for any of the syndromes in this heterogeneous group is a process by which immunologic damage is directed against vessel walls. Ischemic dermatopathy appears clinically as alopecia with crusting and postinflammatory hyperpigmentation or depigmentation. In more advanced cases, erosions and ulcers are present, particularly over bony prominences. Treatment is variably successful and has traditionally included pentoxifylline and vitamin E ± immunosuppressive therapy (eg, corticosteroids, modified cyclosporine).

This article describes 4 cases of canine ischemic dermatopathy; all dogs were <1 year of age, and diagnosis was made based on signalment, clinical presentation, and/or histopathologic changes. Three of the 4 dogs were littermates, and skin biopsies were performed on only 1 of these 3 dogs.

One dog required daily prednisolone (initial dose, 2.4 mg/kg every 24 hours) despite concurrent treatment with modified cyclosporine (5 mg/kg every 24 hours). In this patient, the cyclosporine dose was progressively increased (≤13 mg/kg every 24 hours) for over a year, with only poor clinical improvement observed; cyclosporine was then replaced with mycophenolate mofetil (16 mg/kg every 12 hours). Although clinical improvement was observed with mycophenolate mofetil, severe diarrhea developed. Mycophenolate

mofetil was discontinued for 14 days then reinstated at a lower dose; however, diarrhea reoccurred. Treatment was modified to include prednisolone (0.4 mg/kg every 24 hours) and oclacitinib (0.6 mg/kg every 12 hours), and disease was eventually well controlled with oclacitinib (0.5 mg/kg every 24 hours).

Cases 2, 3, and 4 were littermates that experienced disease control only when receiving modified cyclosporine (≤8.5 mg/kg every 24 hours) and prednisolone (≤0.8 mg/kg every 24 hours). Complete remission was achieved with administration of oclacitinib (0.5-0.7 mg/kg every 12 hours) and prednisolone (0.5-1 mg/kg every 24 hours) for 30 days. The prednisolone dose was tapered and eventually discontinued; lesions remained in complete or near full remission with monotherapy of oclacitinib (0.2 mg/kg every 24 hours in 1 dog, 0.4-0.6 mg/kg every 12 hours in 2 dogs).

... TO YOUR PATIENTS

Key pearls to put into practice:

- 1** Canine ischemic dermatopathy—except for vaccine-associated ischemic dermatopathy—is either genetic (eg, dermatomyositis) or idiopathic in origin.
- 2** Initial therapy with immunosuppressive doses of prednisolone with or without concurrent immunosuppressive agents (eg, modified cyclosporine, mycophenolate mofetil) is typically required for treating generalized ischemic dermatopathy.
- 3** Monotherapy with oclacitinib may be another treatment option for dogs affected by ischemic dermatopathy.

Research Note:

Cardiac Ultrasonography for Detecting Occult Heart Disease in Cats

This prospective cohort study sought to evaluate whether the use of focused cardiac ultrasonography (FCU) performed by nonspecialist clinicians would improve the detection of occult heart disease in cats. Nonspecialist clinicians received FCU training via class, video, and hands-on practice. Cats ($n = 289$) were evaluated by a nonspecialist clinician via physical examination, which was sequentially followed by ECG, FCU, and point-of-care *N*-terminal proB-type natriuretic peptide assay. A board-certified cardiologist then conducted an evaluation of each cat, and levels of agreement between the non-specialist clinician and specialist diagnoses were evaluated. Agreement between nonspecialist clinicians and cardiologists was increased significantly after FCU, particularly in cases of moderate and marked heart disease. It was determined that FCU is a feasible, helpful tool for nonspecialist clinicians, and further investigation of this technique is warranted.

Source

Laughran KA, Rush JE, Rozanski EA, Oyama MA, Larouche-Lebel E, Kraus MS. The use of focused cardiac ultrasound to screen for occult heart disease in asymptomatic cats. *J Vet Intern Med.* 2019;33(5):1892-1901.

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Enteric Microbial Diversity in Diabetic Cats

Andrew C. Bugbee, DVM, DACVIM
University of Georgia

In the Literature

Kieler IN, Osto M, Hugentobler L, et al. Diabetic cats have decreased gut microbial diversity and lack of butyrate producing bacteria. *Sci Rep.* 2019;9(1):4822.

FROM THE PAGE ...

Intestinal flora contributes to several protective and homeostatic mechanisms in the body; alterations to these microbial communities can contribute to systemic inflammation and disease.¹ Diabetes mellitus is a common endocrinopathy in middle-aged to older cats, with a complex pathophysiology that often involves insulin resistance and β -cell dysfunction and injury, culminating in progressive loss of insulin-secreting ability.

In this study, the enteric microbial compositions of 82 cats (23 diabetic; 24 lean and 15 overweight, nondiabetic) were described and compared. The authors also assessed the impact of a 4-week, high-protein, diabetic-formulated diet change on microbial composition in a subset of these cats (11 diabetic; 12 lean and 13 overweight, nondiabetic).

Breed, age, and sex were not found to influence enteric microbial composition. Similarly, no differences in microbial composition were found between lean and obese cats. However, as compared with lean cats, diabetic cats were found to have reduced microbial richness (ie, number of gut microbial genes), gut microbial diversity, and bacteria able to produce the short-chain fatty acid butyrate, a known energy source for colonic epithelial cells and a factor in intestinal glucose and insulin regulation. Most differences found between these groups were caused by a relative reduction in enteric microbial communities, specifically in diabetic cats as compared with lean cats. In addition, following the 4-week diet trial, diabetic cats maintained a reduced microbial richness and diversity as compared with both lean and obese nondiabetic cats. Lower concentrations of various butyrate-producing bacteria were observed in diabetic cats both before and after the diet trial, with additional predictive models suggesting that the gut microbiota in diabetic cats may have an impaired ability to produce vitamin K. Although vitamin K is a known factor involved in hemostasis, the

authors describe its potential additional role in regulating systemic insulin sensitivity.

Of several reported associations between serum chemistry or clinical parameters and enteric microbial composition, the most clinically relevant finding was that serum fructosamine concentrations were negatively correlated with high numbers of gut microbiota of the family Prevotellaceae, which have been associated with improved glucose tolerance, and positively correlated with high numbers of Enterobacteriaceae, a bacterial family associated with low-grade systemic inflammation.

... TO YOUR PATIENTS

Key pearls to put into practice:

- 1 Diabetic cats appear to have relative enteric dysbiosis as compared with healthy lean and obese cats, which could impact diabetes mellitus pathogenesis or, possibly, patient response to management.
- 2 Results of blood glucose testing, including serum fructosamine concentrations, may be influenced by a patient's enteric microbial composition.
- 3 High-protein, diabetic-formulated diets appear to increase enteric microbial diversity in nondiabetic cats but do not exert a similar influence in diabetic cats. Further study is needed to determine if other interventions (eg, probiotics) can assist in overcoming this dysbiosis.

Reference

1. O'Hara AM, Shanahan F. The gut flora as a forgotten organ. *EMBO Rep.* 2006;7(7):688-693.

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Incision Length & Suture Number for Prophylactic Gastropexy

Susanna Hinkle Schwartz, DVM, DACVS

MedVet

Cincinnati, Ohio

In the Literature

Webb RJ, Monnet E. Influence of length of incision and number of suture lines on the biomechanical properties of incisional gastropexy. *Vet Surg.* 2019;48(6):933-937.

FROM THE PAGE ...

Gastric dilatation-volvulus (GDV) is a rapidly progressing, life-threatening condition that affects large-breed, deep-chested dogs. Even with surgical treatment and aggressive care, mortality in GDV cases ranges from 16% to 24%.¹ Elective prophylactic gastropexy can be performed in susceptible dogs to prevent volvulus of the stomach. Gastropexy can be performed laparoscopically, via laparoscopically assisted methods, or via traditional laparotomy. The risk for GDV after prophylactic gastropexy performed using appropriate surgical technique is low, and there are no long-term risks.² Among the many different methods for gastropexy, incisional gastropexy is commonly used and involves making an incision in the pyloric antrum and a right-sided incision in the transverse abdominis muscle caudal to the last rib. The typical length of the incision is 3 to 5 cm, but the optimum length and number of suture strands has not been determined.

In this study, the stomach and abdominal wall of 36 crossbreed hound dogs euthanized for reasons unrelated to the study were harvested, and gastropexy was performed by a single surgeon. The samples were divided into 4 groups: 2-cm incision using 2 sutures, 2-cm incision using 1 suture, 4-cm incision using 2 sutures, and 4-cm incision using 1 suture. All incisions were closed using 2-0 polyglyconate suture on a tapered-point needle. Mechanical testing was performed to assess the load to failure of each gastropexy construct.

Results showed that the load to failure was affected by the length of the incision but not the number of sutures used. Although the 4-cm incision was stronger than the 2-cm incision, the difference was negligible. Clinically, the strength required for safe gastropexy is unknown, so all constructs may be strong enough in a live animal.

... TO YOUR PATIENTS

Key pearls to put into practice:

1 Owners should be educated about the need for prophylactic gastropexy in large-breed, deep-chested dogs, as the risk for GDV after gastropexy is low. Prophylactic gastropexy should particularly be considered when spaying dogs or performing abdominal surgery in any at-risk dog.

2 Using either a 1- or 2-suture line when closing the incision in the pyloric antrum and a right-sided incision in the transverse abdominis muscle should be sufficient for prophylactic gastropexy.

3 Mechanically, 1- and 2-suture lines were found to be of similar strength; however, if only 1 suture is used and it fails, the entire gastropexy could unravel. Thus, a second suture line can act as potential reinforcement.

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1. Rawlings CA. Incisional gastropexy to prevent and treat canine gastric dilatation-volvulus. *Comp Cont Educ Pract.* 2013;35(4):E1-E5.
2. Benitez ME, Schmiedt CW, Radlinsky MG, Cornell KK. Efficacy of incisional gastropexy for prevention of GDV in dogs. *J Am Anim Hosp Assoc.* 2013;49(3):185-189.

Research Note: **Stability & Profiling of Urinary MicroRNAs in Cats with Pyelonephritis**

Diagnosis of pyelonephritis in cats is usually based on clinical signs, laboratory testing, and ultrasonographic findings, although definitive diagnosis requires positive urine culture obtained via pyelocentesis. MicroRNAs have been studied as biomarkers of renal injury in humans. This prospective case-control study sought to evaluate the presence and stability of microRNAs in cat urine and the discriminatory potential of selected urinary microRNAs for pyelonephritis. Several microRNAs were detected in urine, although storage temperature affected yield. There was upregulation of miR-16 in cats with pyelonephritis, but further research is needed to determine whether this is pyelonephritis-specific, pathogen-specific (ie, *Escherichia coli*), or both.

Source

Jessen LR, Nielsen LN, Kieler IN, Langhorn R, Reezigt BJ, Cirera S. Stability and profiling of urinary microRNAs in healthy cats and cats with pyelonephritis or other urological conditions. *J Vet Intern Med.* 2020;34(1):166-175.



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Improving Prediction of Mast Cell Tumor Behavior

Timothy M. Fan, DVM, PhD, DACVIM
(Oncology, Internal Medicine)
University of Illinois at Urbana–Champaign

In the Literature

Reynolds BD, Thomson MJ, O’Connell K, Morgan EJ, Gummow B. Patient and tumour factors influencing canine mast cell tumour histological grade and mitotic index. *Vet Comp Oncol.* 2019;17(12):1-7.

FROM THE PAGE ...

Collectively, mast cell tumors (MCTs) are the most common malignant neoplasms diagnosed in dogs, accounting for less than ≈20% of all skin cancers.¹ Significant clinical and research efforts have been made to better understand the biologic behavior of MCTs, which, in turn, informs clinical prognosis and helps guide treatment options for affected patients.

Although several variables have been evaluated in the prediction of canine MCT behavior,^{2,3} histopathologic evaluation remains a cornerstone for assessing whether MCT biology is benign or aggressive and includes



▲ FIGURE A severe, expansive, and infiltrative MCT involving the inguinal region in a geriatric female shar-pei demonstrating supportive correlation of a high histopathologic grade (ie, III) MCT with identified clinical variables, including host-centric (ie, breed [shar pei]) and tumor-centric (ie, anatomic location [inguinal]) factors. *Images provided by Dr. Fan*

histopathologic grade and proliferative indices.⁴⁻⁶ Although valuable, histopathology alone is an imperfect predictor of MCT biologic behavior, and the synergistic integration of clinical factors, along with pathology, can provide improved MCT biology prediction. As such, correlative investigations can provide actionable findings and should be conducted to identify new—and strengthen previously observed—associations between histopathologic grade and unfavorable clinical variables of the host (eg, breed) and tumor (eg, location). Findings derived from such studies offer opportunities to combine traditional pathology with clinical acumen for the best clinical management practices for canine MCTs.

Over a 15-year period, this retrospective study examined tumor and host variables of dogs that had MCTs. Of 400 MCTs identified, 90 were categorized as having a high histopathologic grade (via the Patnaik, Kiupel, and/or mitotic index classification) and were associated with a variety of tumor and host factors identified through physical examination and owner–clinician communication. Tumor-specific variables included lesion size and anatomic location, and host factors focused on patient signalment (eg, breed, age, sex, neuter status).

Although tumor size was not identified to be associated with a high histopathologic grade, MCTs arising from the inguinal or head regions had an increased risk for having a high histopathologic grade. In addition, MCTs arising from collective “unfavorable” sites, termed *PIMP* (ie, perineal, inguinal, mucocutaneous junctions, and perianal)

locations, were also more likely to have a high histopathologic grade. Of the host factors examined, the sharpei breed had an increased risk for being diagnosed with histopathologically high-grade tumors. In aggregate, MCT location and patient breed were also correlated with high histopathologic grade pathology findings.

... TO YOUR PATIENTS

Key pearls to put into practice:

- 1 MCTs are common skin cancers that can be benign or malignant.
- 2 Histopathology remains the gold standard for disease prognostication but is imperfect and should not be used as a sole predictor of biologic behavior.

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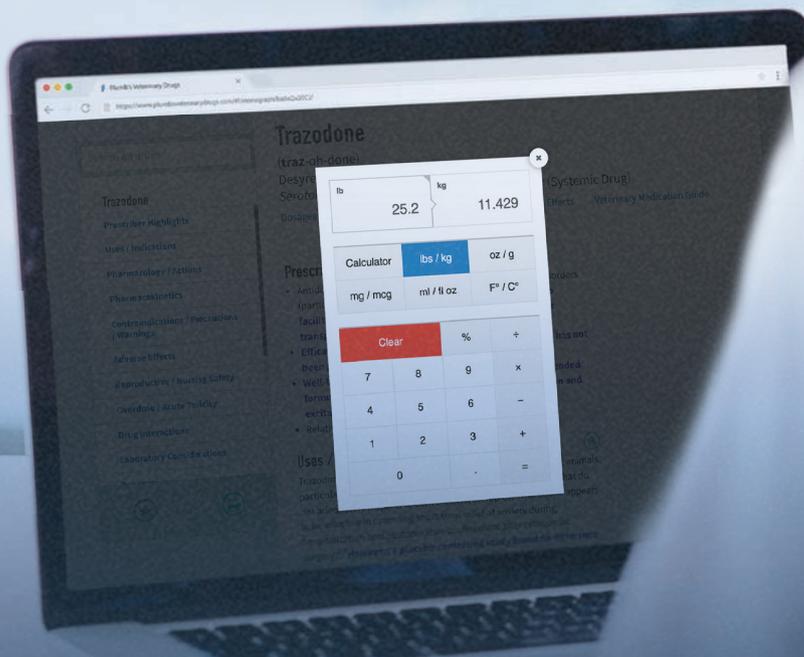
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Mast cell tumors arising from the inguinal or head regions had an increased risk for having a high histopathologic grade.



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Nonregenerative Anemia in Cats

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University of Georgia

In the Literature

Olson SW, Hohenhaus AE. Feline non-regenerative anemia: diagnostic and treatment recommendations. *J Feline Med Surg.* 2019;21(7):615-631.

FROM THE PAGE ...

This article reviews common causes of nonregenerative anemia in cats and provides a stepwise approach to diagnostic investigation and management. The authors divide differentials into 2 categories for pathologic mechanism. The first category is ineffective erythropoiesis involving conditions impacting bone marrow production of RBCs; this category includes nutrient deficiencies (eg, iron, vitamin B12), infectious diseases (eg, FeLV, FIV), and primary bone marrow disorders (eg, precursor-directed immune-mediated anemia). Conditions outside the bone marrow that can cause nonregenerative anemia (eg, chronic inflammatory states, lack of erythropoietin associated with later stages of chronic renal disease) are also included in this category. The second category is reduced RBC lifespan and includes conditions leading to the premature removal of RBCs from circulation (eg, following oxidative stress or injury).

Nonregenerative anemia involves insufficient numbers of identifiable aggregate reticulocytes in circulation. This is typically defined as an absolute aggregate reticulocyte count of $<60,000/\mu\text{L}$; however, gradations in regenerative response (ie, strongly, moderately, and weakly regenerative) have been reported based on the absolute reticulocyte number and reticulocyte percentage. The authors stress the importance of assessing reticulocyte counts immediately, as the cells will continue to mature following collection, thereby preventing accurate reticulocyte quantification. Because the differentials list for feline nonregenerative anemia is long, use of an algorithm can help guide diagnostic decisions to minimize unnecessary testing and maximize the chance of obtaining a diagnosis. Minimum database testing as indicated is often followed by more specific investigations (eg, infectious disease screening, assessment for systemic disease [eg, chest and/or abdominal imaging], specific nutrient analysis [eg, iron panel, cobalamin

concentration]). If a causative disease is not identified noninvasively, bone marrow aspiration \pm core biopsy will likely be necessary.

Treatment is specifically targeted toward the underlying condition diagnosed. This may include supportive therapies for chronic blood loss or supplementation of nutrient or erythropoietin deficiencies. Autoimmune conditions are treated similarly to peripheral hemolytic anemia, with immunosuppressive protocols usually including a glucocorticoid and occasionally requiring a secondary agent. Cats that are hemodynamically unstable should receive blood type evaluation and a packed RBC transfusion.

... TO YOUR PATIENTS

Key pearls to put into practice:

- 1 Due to the diversity of differentials for feline nonregenerative anemia, consideration should be given to primary bone marrow disorders as well as systemic infectious, inflammatory, and neoplastic conditions known to impact RBC production and survival.
- 2 A reticulocyte count should be obtained soon after blood sampling to maximize accuracy of the quantification.
- 3 Because treatments are often targeted toward a specific causative condition, the diagnostic investigation should be comprehensive and may require assessment of a bone marrow aspiration \pm core biopsy.

Adequate Analgesia for Ear Procedures

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Madison, Wisconsin

In the Literature

Layne EA, de Miguel Garcia C. Clinical techniques in veterinary dermatology: regional anaesthesia of the canine ear. *Vet Dermatol.* 2019;30(6):470-e138.

FROM THE PAGE ...

This study describes a technique for performing regional anesthesia in canine ears, which is particularly important during otoscopy and deep ear flushing. Otoscopic procedures can be painful and require profound sedation or anesthesia. Regional nerve blocks with lidocaine and bupivacaine block sensation to the affected area and allow for decreased anesthetic doses. These blocks may also be useful in dogs undergoing total ear canal ablation and bulla osteotomy. The 2 nerves that provide sensory innervation of the ear canal and pinna are the great auricular nerve and auriculotemporal nerve.

To block the great auricular nerve, the transverse process of the atlas (C1) should be palpated. A 22 g × 3.5" spinal needle is inserted at the skin caudal to C1 and aimed toward the deep fascia at the level of the transverse process of C1. Needle insertion is superficial, with the tip of the needle pointing rostrally. Negative aspiration of blood should be ensured. The total dose is injected in 3 equal amounts along the transverse process as the needle is retracted.

To block the auriculotemporal nerve, the temporomandibular joint (TMJ) is first localized by opening and closing the mouth while palpating the area over the TMJ. After locating the TMJ, a 22 g × 1.5" spinal needle should be inserted perpendicular to the skin toward the TMJ. The needle should be held in contact with the zygomatic arch at the level of the masseteric margin. After negative aspiration of blood is ensured, the drug can be injected.

Lidocaine or bupivacaine can be used. The upper dose limit is 5 mg/kg for lidocaine and 2 mg/kg for bupivacaine. The desired total volume for injection for the great auricular nerve is 0.2 mL/kg; the volume for the auriculotemporal nerve is 0.04 mL/kg. The dose can be diluted with saline to achieve total volume in cases in which the upper limit of the dose prohibits using the desired volume of the drug by itself (eg, in smaller dogs).

... TO YOUR PATIENTS

Key pearls to put into practice:

- 1 Deep ear flushing in dogs with severe otitis can be painful and thus requires significant sedation or anesthesia. The ear blocks described can allow for lower doses to be administered; as a result, recovery can be improved and anesthetic depth can be lighter.
- 2 Ear flushing is an underused tool to treat chronic otitis and should be considered in any patient that has chronic otitis or suspicion of otitis media.

Ear blocks can allow for lower doses to be administered; as a result, recovery can be improved and anesthetic depth can be lighter.

Hemp Oil & Cannabidiol: What Clinicians Should Know

Clinicians are likely seeing owners of pets that are receiving cannabidiol (CBD) supplements; thus, it is important for clinicians to be knowledgeable of hemp-based CBD products and how they work. CBD is increasing in popularity and is being used as an adjunct or alternative treatment option for a wide range of conditions in pets. This growing interest may be due to recent legal changes or an increasing understanding of CBD. Increasing marijuana use may have also contributed to this interest.

KEY POINTS

- ▶ The endocannabinoid system is an increasingly researched target of action that appears to be involved in target system homeostasis.
- ▶ Clinicians should be knowledgeable of the potential differences among *Cannabis sativa* products.
- ▶ Available research suggests there is great potential variation in product quality and pharmacokinetics between brands.

Definitions

Cannabis sativa is a plant that has been used for both medicinal and recreational purposes for centuries. Industrial hemp is the legal term for any strain of *Cannabis sativa* with <0.3% of Δ -9-tetrahydrocannabinol (THC), and marijuana is a strain of *Cannabis sativa* with greater THC content.¹

Cannabis sativa has chemical compounds known as phytocannabinoids and other phytochemicals (eg, terpenes, flavonoids). There are >100 different phytocannabinoids that have been identified and may be present in the different strains of *Cannabis sativa*.² The amount and type of phytocannabinoids present can be influenced by many factors, such as strain and growing location.³ Two well-known and researched phytocannabinoids are CBD and THC. These phytocannabinoids work in the endocannabinoid system (ECS) of the body, a newly discovered body system.⁴

The Endocannabinoid System

The ECS is a broad-spectrum system that acts as a modulator or regulator for many different body systems. It is also involved, to some degree, in most basic bodily functions. The overall guiding purpose of the ECS is to maintain a stable state (ie, homeostasis) in each system it is involved in.⁵

Endogenous compounds bind to ECS receptors throughout the body. Several ECS receptors have been identified, but CB1 and CB2 are the most well-known. CB1 and



CB2 are G protein-coupled receptors found in the cytoplasm of cells. CB1 receptors are most commonly found in the CNS, whereas CB2 receptors are primarily associated with immune cells, but both can be found throughout the body. The body synthesizes endocannabinoids, with the 2 best characterized endocannabinoids being anandamide (AEA) and 2-arachidonoylglycerol (2-AG). AEA and 2-AG, both endogenous endocannabinoids, are capable of acting as agonists or antagonists on their corresponding receptors. Phytocannabinoids that are not endogenous but plant-based (eg, CBD, THC) appear to alter the ECS system similarly to AEA and 2-AG either by directly binding to the cannabinoid receptors or through

a host of other receptors that regulate body responses (eg, appetite, behavior, inflammation).^{6,7}

Hemp Oil Variants

There are 3 main classifications of hemp oil in the market: isolate, broad-spectrum hemp, and full-spectrum hemp. An isolate is usually described as a product that isolates and contains a single phytocannabinoid, typically CBD. Broad-spectrum hemp oils are a group of extracted isolates like phytocannabinoids, terpenes, and/or flavonoids that are blended together with a carrier oil. Full-spectrum hemp oils contain all of the phytocannabinoid, terpenes, and/or flavonoids that are present in the plant. The “entourage effect” occurs when all of these components are able to work with each other to potentially provide additional or greater benefits than the phytocannabinoids and terpenes could provide individually.²

Hemp Oil Research

There are few published studies that have researched the safety, efficacy, and pharmacokinetics of hemp oil in dogs. Ongoing efficacy studies are evaluating hemp oil for possible use for other indications. Because not all hemp oil products are equal, selecting a product from a company with a known history of excellent quality control and assurance is crucial. In a recent study of commercial veterinary hemp products, only 23% (3/13) of hemp oil extracts met the levels stated on the label; the remaining 77%

(10/13) either made no label claim or contained less than what was stated on the label.⁸

Additional studies of the pharmacokinetics in both dogs and cats are also being performed at major veterinary universities. Auburn University has been conducting some initial pharmacokinetic research on Chroniquin, a full-spectrum hemp oil product.⁹ This initial pharmacokinetic research on Chroniquin was compared with the published pharmacokinetic data on other veterinary hemp oil products; Chroniquin was shown to provide a longer CBD half-life and higher serum concentrations of CBD 24 hours postadministration as compared with published data on other products, despite some of those products having administration rates up to 5 times higher than that of Chroniquin (2 mg/kg).^{10,11}

Conclusion

As the use of hemp oil products increases and more CBD-rich research is published, veterinary healthcare providers should become aware and knowledgeable of CBD products, as well as the laws and regulations regarding the legality of recommending CBD products in their area of practice. Clinicians should also be able to relay to pet owners the importance of selecting a safe, quality product from a trusted company for their pets. ■

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Predicting Death in Canine Acute Pancreatitis

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In the Literature

Fabrès V, Dossin O, Reif C, et al. Development and validation of a novel clinical scoring system for short-term prediction of death in dogs with acute pancreatitis. *J Vet Intern Med.* 2019;33(2):499-507.

FROM THE PAGE ...

Acute pancreatitis is a common disease in dogs. Severity can range from mild pancreatitis with GI signs to necrotizing pancreatitis that leads to multiorgan failure and death. Early detection of pancreatitis has improved with recently developed diagnostic tests,¹ but these tests are imperfect. In humans, early recognition of the more severe forms of pancreatitis are critical to improving patient outcome, and multiple scoring systems are used.²

This multicenter, retrospective cohort study sought to develop a scoring system based on independent predictors of short-term death (ie, within 30 days) in dogs that had acute pancreatitis ($n = 138$) and to validate the scoring system in an external population of dogs that had acute pancreatitis ($n = 31$). In the cohort of 138 dogs, the case fatality rate 30 days after admission was 33%.

Independent risk factors for short-term death identified in this study included presence of systemic inflammatory response syndrome, coagulation disorders, increased creatinine, and ionized hypocalcemia. Using these risk factors, the authors proposed 2 scoring systems: the Canine Acute Pancreatitis Severity scoring system and a simplified version of this system that could be used for a faster calculation.

... TO YOUR PATIENTS

Key pearls to put into practice:

- 1** Secondary causes of acute pancreatitis (eg, foreign body obstruction, neoplasia) should be ruled out via imaging prior to considering primary pancreatitis, as early intervention can impact outcome.
- 2** Acute kidney injury evidenced by a rising creatinine value—even if still in the normal range—has been identified as a negative prognostic indicator for many severe illnesses; creatinine should be closely monitored in acute pancreatitis patients.
- 3** Frequent re-evaluation of dogs with acute pancreatitis is critical for early recognition of risk factors so that treatment may be altered to improve outcome and provide realistic prognoses.

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01AD-ZYC50104-0220

Canine Hemangiosarcoma

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Canine hemangiosarcoma (HSA) is a highly malignant solid tumor that arises from the malignant transformation of endothelial cells or from neoplastic bone marrow progenitor cells of hemangioblast differentiation.¹⁻³

Background & Pathophysiology

HSA can develop in any vascular organ or tissue but is most commonly found in the spleen (≈50%), right atrium and/or auricle (≈25%), and skin or SC tissue (≈15%; **Figure 1**, next page).⁴ Most dogs diagnosed with HSA are geriatric, with a predisposition observed in German shepherd dogs, golden retrievers, and Labrador retrievers.⁵⁻⁷ Splenic HSA is a common splenic malignancy and is accompanied by life-threatening complications (ie, hemoabdomen and distant metastases).⁸⁻¹¹ The mode of metastatic spread varies for patients with HSA that involves the abdominal visceral organs (eg, spleen, liver, kidneys). Regional dissemination of disease in the abdominal cavity or retroperito-

neal space is enabled by the local deposition of tumor cells following primary tumor rupture, but distant metastasis requires hematogenous circulation, vascular entrapment, and successful colonization of detached tumor cells. Common metastatic sites include the liver, omentum, mesentery, and lungs.^{7,12} HSA also tends to metastasize to the CNS.^{13,14}

Although HSA involving visceral organs is typically uniformly malignant, the biologic behavior of cutaneous HSA varies in aggressiveness and depends on the extent of localized (dermal, hypodermal/SC, or muscular) invasion. In dog breeds with short hair and minimal pigmentation, sun exposure (ie, actinic induction) is a risk factor for superficial cutaneous HSA.^{15,16} This dermally confined variant of HSA tends to be less aggressive due to lack of subdermal penetration and reduced capacity for establishing distant metastases as compared with HSA that involves deeper adnexal structures (including tissues of the subcutis and muscle).^{15,17-21}

HSA = hemangiosarcoma

History

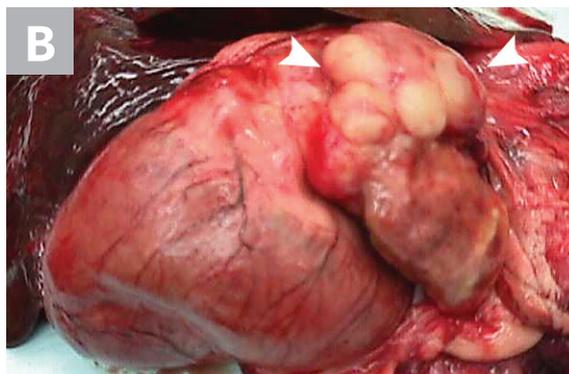
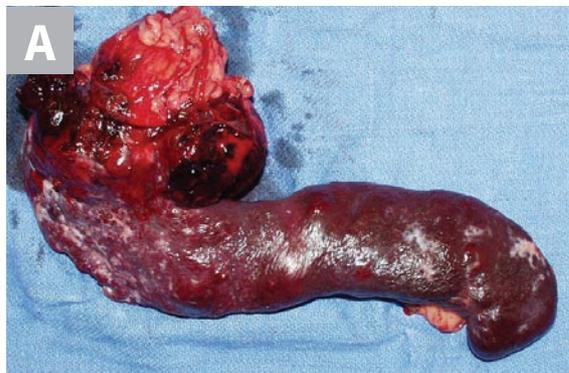
Many dogs with HSA remain clinically normal for relatively long periods of time (ie, months) during malignant progression. An HSA diagnosis involving visceral organs is often precipitated by sudden life-threatening signs related to hemodynamic collapse following acute, nontraumatic organ rupture and consequent hemoabdomen. In affected dogs that do not experience life-threatening hemorrhage, clinical signs of nonspecific lethargy may fluctuate and an episodic pattern related to intermittent hypovolemia associated with acute third-space blood loss may be exhibited.

Clinical Signs

Clinical signs are nonspecific and depend on the anatomic location of the primary tumor as well as the magnitude and severity of resultant hemorrhage

and hypovolemic shock. Common clinical signs include acute-onset lethargy, weakness, collapse, pale mucous membranes, delayed capillary refill time, tachycardia, cardiac arrhythmias, and poor pulse quality. If blood loss is self-limiting, these hemodynamic perturbations are not imminently life-threatening; clinical signs may be episodic in nature and a full clinical recovery may follow within days. However, when hemorrhage is severe, hemodynamic collapse and sudden death are possible.

A large space-occupying mass may be palpable with visceral organ (splenic or hepatic) HSA. In addition, tumor rupture can result in abdominal distention and ballottement of a fluid wave secondary to hemorrhagic effusion. With cardiac HSA, malignant arrhythmias (eg, ventricular premature contractions), muffled heart sounds, venous congestion (eg,



▲ **FIGURE 1** Primary noncutaneous HSA involving the head of the spleen (A) and the right auricle (B, arrowheads). Images courtesy of Laura Garrett, DVM, DACVIM (Oncology), and Louis-Philippe de Lorimier, DVM, DACVIM (Oncology)



▲ **FIGURE 2** Primary HSA involving SC tissue. Image courtesy of Louis-Philippe de Lorimier, DVM, DACVIM (Oncology)

jugular pulses, facial edema, hepatic venous congestion with effusion) associated with right-sided heart failure, and signs compatible with cardiac tamponade may be observed. Primary HSA lesions involving the superficial dermis may appear as well-defined blood blisters. HSA from the SC and IM tissues may appear as large and firm or fluctuant masses (**Figure 2**); overlying skin may have extensive ecchymosis, swelling, discoloration, and ulceration.

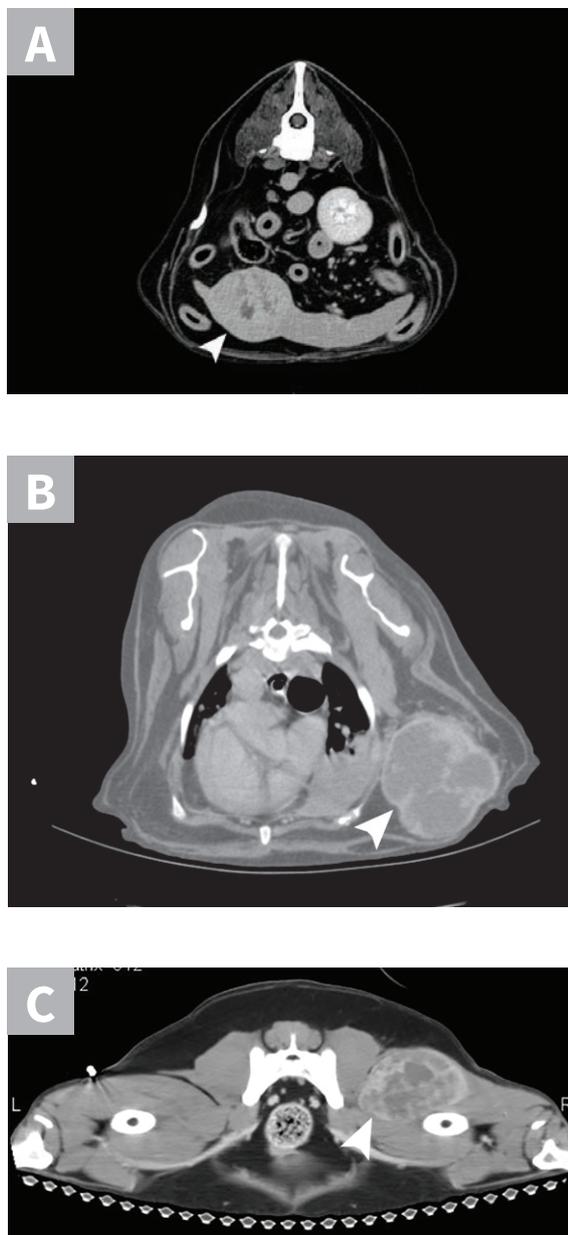
Diagnosis

Although HSA can be presumptively diagnosed based on multiple clinical and physical findings and patient signalment, baseline diagnostic tests (see **Baseline Diagnostic Tests**, page 61) should be considered in patients that have probable HSA. Detailed images of HSA lesions arising from visceral organs, SC tissue, and deeper muscle structures can be acquired with advanced imaging modalities (eg, CT; **Figure 3**).

Definitive diagnosis of HSA requires microscopic identification of tumor cells through cytology or histopathology. Due to the poorly exfoliative nature of mesenchymal tumors coupled with the hemorrhagic nature of HSA, fine-needle aspiration cytology often produces samples of low cellularity with rare identification of malignant cells (**Figure 4**, next page). Cytologic examination of hemorrhage effusions is not typically helpful or diagnostic for HSA because of the low numbers of neoplastic cells admixed with a large volume of blood. Biopsy is suggested for definitive diagnosis because benign lesions (ie, splenic hematoma) can have clinical presentations (ie, splenic mass with associated hemoabdomen) similar to malignant HSA. Excisional biopsy is preferred because it is diagnostic and therapeutic. All resected tissue samples should be evaluated for histologic features of malignancy and immunohistochemically stained for endothelial markers (eg, CD31).

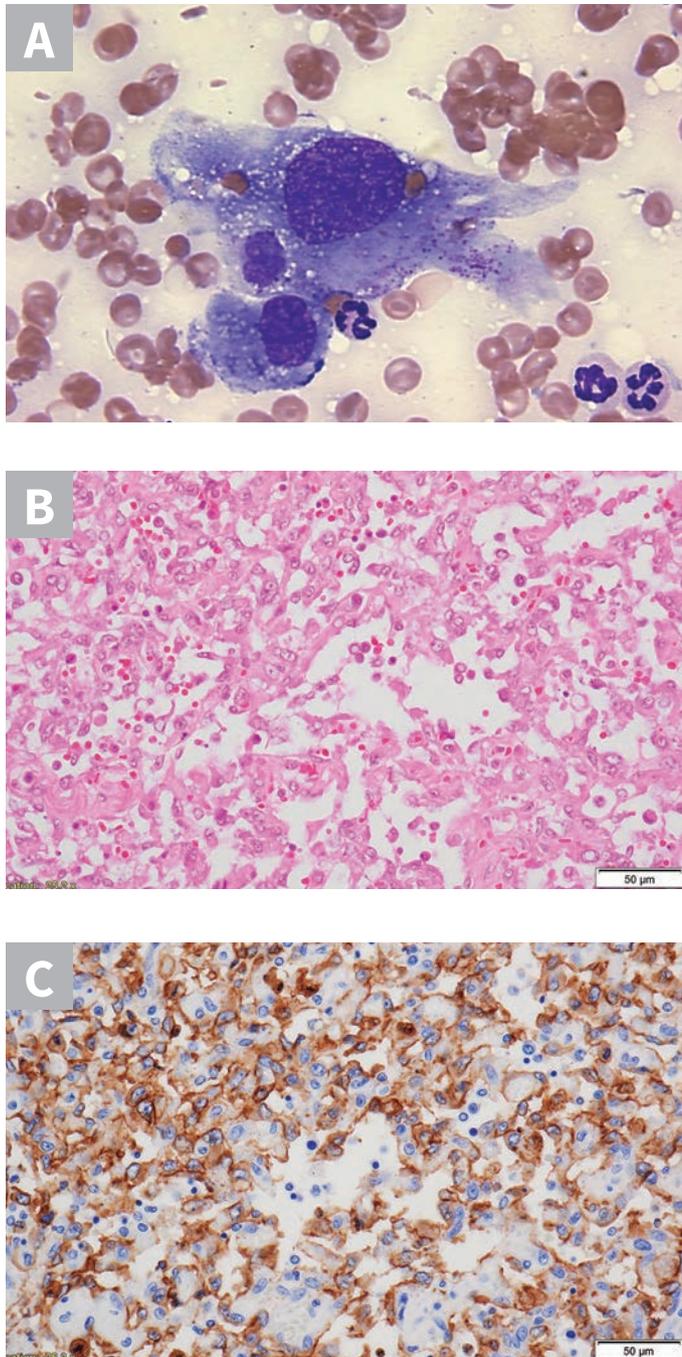
Treatment & Management

Effective management of HSA is difficult, as therapeutic options (eg, surgery for cardiac HSA) can be associated with high morbidity, and palliative



▲ **FIGURE 3** CT images of primary splenic HSA (**A**, **arrowhead**), SC HSA (**B**, **arrowhead**), and deep-muscle HSA (**C**, **arrowhead**). Figures courtesy of Louis-Philippe de Lorimier, DVM, DACVIM (Oncology)

HSA = hemangiosarcoma



▲ **FIGURE 4** Cytology showing malignant mesenchymal cells with multiple criteria for cellular malignancy (eg, anisocytosis, anisokaryosis; **A**); histopathology of the splenic mass demonstrating malignant spindle cells forming haphazard and disorganized vascular channels (**B**) and strong positivity for the expression of CD31 (PECAM-1), which is represented by brown membranous staining of HSA cells and confirms that malignant cells are of endothelial origin (**C**). Images courtesy of Anne Barger, DVM, MS, DACVP, and Jonathan Samuelson, DVM, DACVP

treatments (eg, radiation therapy) result in only marginal improvements in overall survival times. However, based on the biologic behavior of most HSA cases, comprehensive treatment plans should include a combination of localized and systemic therapeutic strategies except in cases of superficial dermal HSA, which can be treated with surgical resection alone. In patients with cardiac HSA, local treatment performed by a skilled surgeon can be attempted with the aim of resecting or cytoreducing primary tumors that involve the atrium or auricle; however, morbidity (and mortality) can be associated with these interventions. Pericardiectomy may be performed to mitigate the development of cardiac tamponade and associated hemodynamic compromise.^{22,23} Ionizing radiation therapy can also be used for localized treatment of SC- or muscle-invasive HSA, in which effective surgical intervention is anatomically infeasible.²⁴ Although localized interventions (ie, surgery, radiation) are frequently palliative in nature and have the potential to control clinical signs associated with hemorrhage and pain, definitive efficacy of these treatment options remains speculative and prospective clinical trials are needed. Splenectomy followed by adjuvant systemic chemotherapy remains the standard of care for splenic HSA. In most anatomic forms of HSA, except superficial dermal involvement, regional and distant metastases can develop rapidly, and most dogs succumb to disseminated disease progression. The highly metastatic nature of HSA has been thoroughly documented in dogs with splenic HSA, in which a median survival time of 1.6 months is expected in dogs treated with splenectomy alone.¹¹

Chemotherapeutic approaches can support a marginally to modestly improved survival time (4-8 months) of dogs with HSA (mostly splenic) treated with systemic, maximum-tolerated-dose chemotherapy, primarily with a doxorubicin backbone protocol. Attempts to identify adjuvant and/or alternative systemic therapies (eg, metronomic chemotherapy, receptor tyrosine kinase inhibitors) to extend survival times have been largely unsuccessful.^{12,25-27} Novel strategies that include

administration of bispecific drug conjugates, inhibition of β -adrenergic signaling, and chemoimmunotherapy with dendritic cell vaccination and low-dose doxorubicin therapy are promising and under investigation²⁸⁻³⁰; however, these strategies are not in mainstream use for dogs with HSA.

Dogs with HSA may also clinically benefit from alternative complementary therapies such as Yunnan Baiyao and a commercially available proprietary polysaccharopeptide (PSP) extract. Yunnan Baiyao has been recently investigated for its potential procoagulant properties.^{31,32} In healthy beagles, Yunnan Baiyao has been shown in some studies, but not in others, to increase the strength of blood clot formation as measured by thromboelastography.^{31,32} In dogs presented with presumed HSA, Yunnan Baiyao may improve postoperative surgical outcomes but requires future prospective studies to define its role in HSA management. Similar to Yunnan Baiyao, the PSP extract is a mushroom extract believed to act as an immunostimulant and has shown some potential in delaying the onset of abdominal metastases following splenectomy in a small pilot study.³³ Although initial results for the PSP extract are promising, additional and larger prospective studies evaluating its clinical benefit have not been published. The PSP extract's role in HSA management therefore remains incompletely defined.

Clinical Follow-Up & Monitoring

Early disease screening and tumor burden monitoring through routine radiography and sonography or molecular diagnostics can provide information on HSA disease status for pet owners

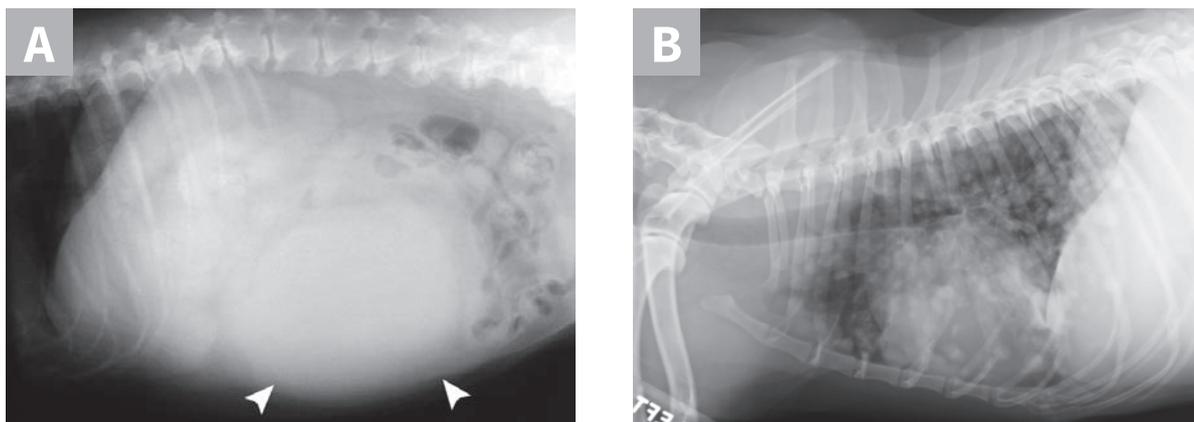
BASELINE DIAGNOSTIC TESTS

Test results are listed in parentheses.

- ▶ CBC (anemia, schistocytes, thrombocytopenia)
- ▶ Serum chemistry profile (hypoproteinemia secondary to blood loss, liver enzyme elevation)
- ▶ Coagulation panel (elevated prothrombin time/partial thromboplastin time secondary to disseminated intravascular coagulation)
- ▶ Abdominal and thoracic radiography (mass effect or pulmonary metastases; **Figure 5**)
- ▶ Echocardiography (right auricle mass effects; **Figure 6**, next page)
- ▶ Abdominal ultrasonography (mixed echogenic mass lesions involving visceral organs)
- ▶ Additional radiography studies of affected anatomic sites (**Figure 7**, next page)
- ▶ Advanced imaging modalities (eg, CT)

HSA = hemangiosarcoma

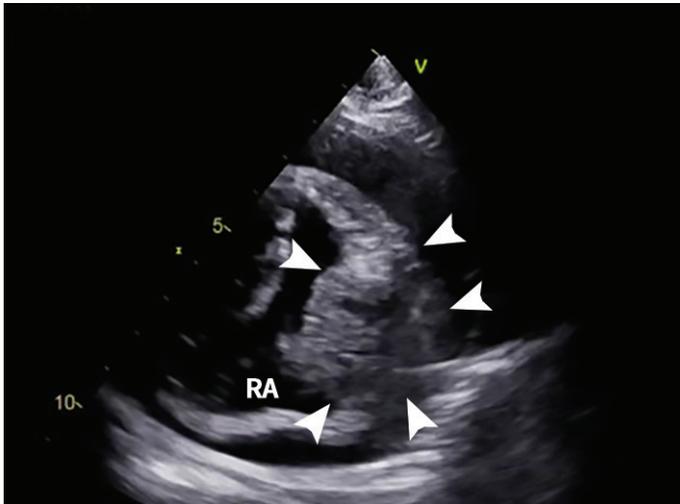
PSP = proprietary polysaccharopeptide



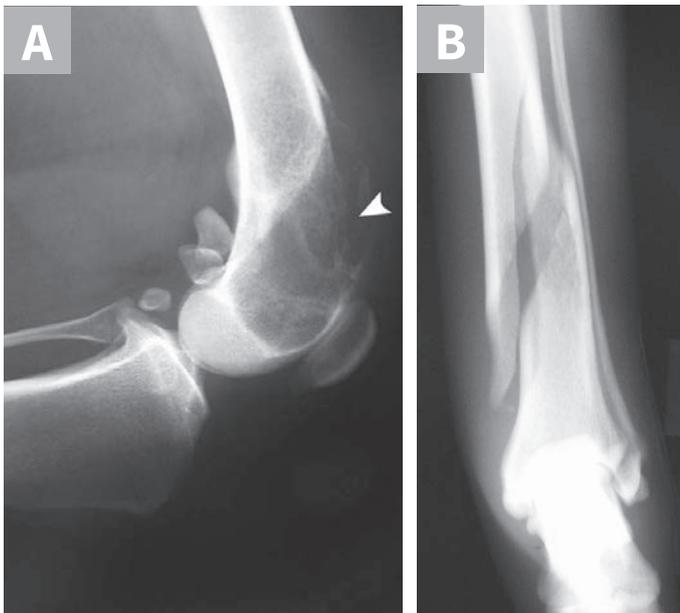
▲ **FIGURE 5** Radiography findings consistent with primary splenic HSA (**A**, **arrowheads**) and advanced HSA pulmonary metastatic disease (**B**). Figures courtesy of Louis-Philippe de Lorimier, DVM, DACVIM (Oncology)

and can improve clinical management of initial or recurrent HSA lesions. This is supported by superior survival outcomes in dogs diagnosed with early- versus late-stage disease.^{11,34,35} Because HSA

rapidly progresses, follow-up examination including blood work and monitoring (via thoracic radiography and abdominal ultrasonography) should be routinely performed, with follow-up scheduled depending on stage of disease, speed of disease progression, clinical signs, and owner compliance. Dogs treated with splenectomy and systemic chemotherapy that remain clinically stable should be re-examined every 8 weeks; this allows for local and/or systemic intervention when recurrent and/or metastatic disease is incipient. ■



▲ **FIGURE 6** Echocardiography finding consistent with right atrial HSA (arrowheads). RA, right atrium. Figure courtesy of Saki Katotani, DVM, DACVIM (Cardiology)



▲ **FIGURE 7** Radiography findings consistent with purely lytic bone lesions (arrowhead) with associated spiral fracture secondary to primary bone HSA. Figures courtesy of Louis-Philippe de Lorimier, DVM, DACVIM (Oncology)

HSA = hemangiosarcoma

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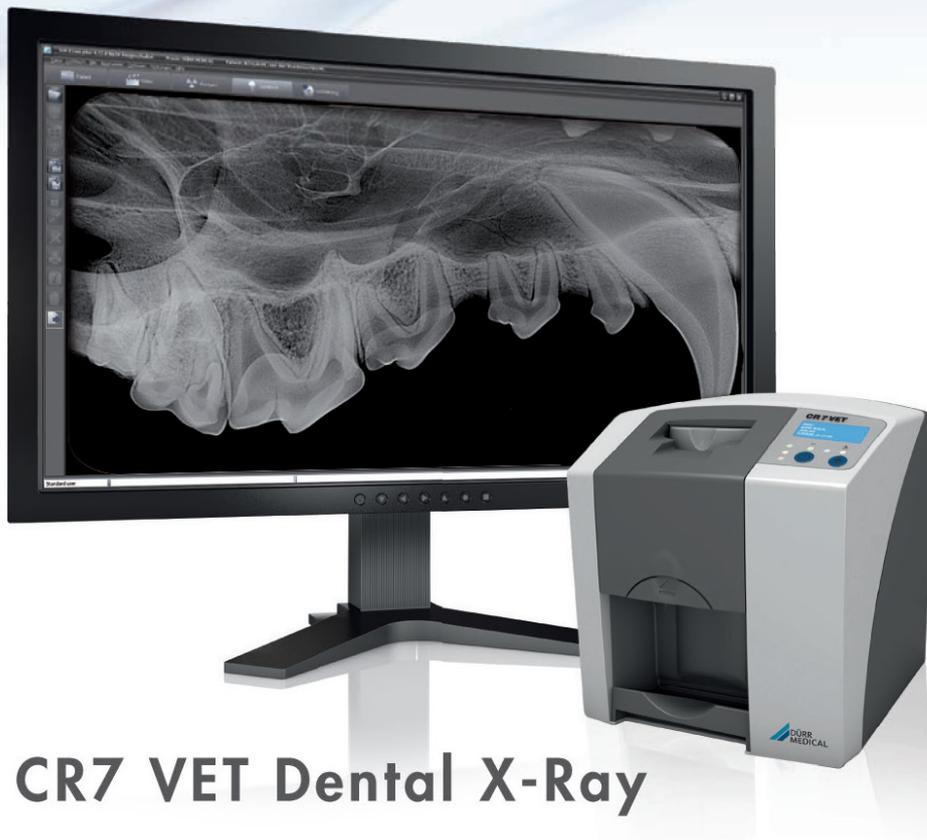
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Bilateral Iatrogenic Mandibular Fracture

Gottfried Morgenegg, DVM

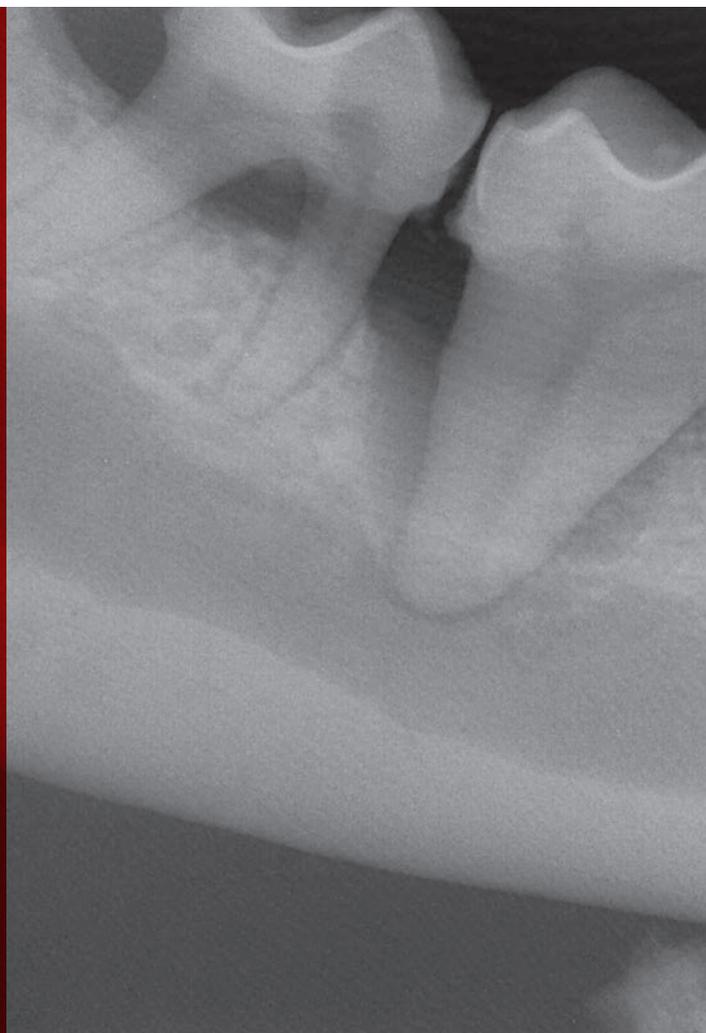
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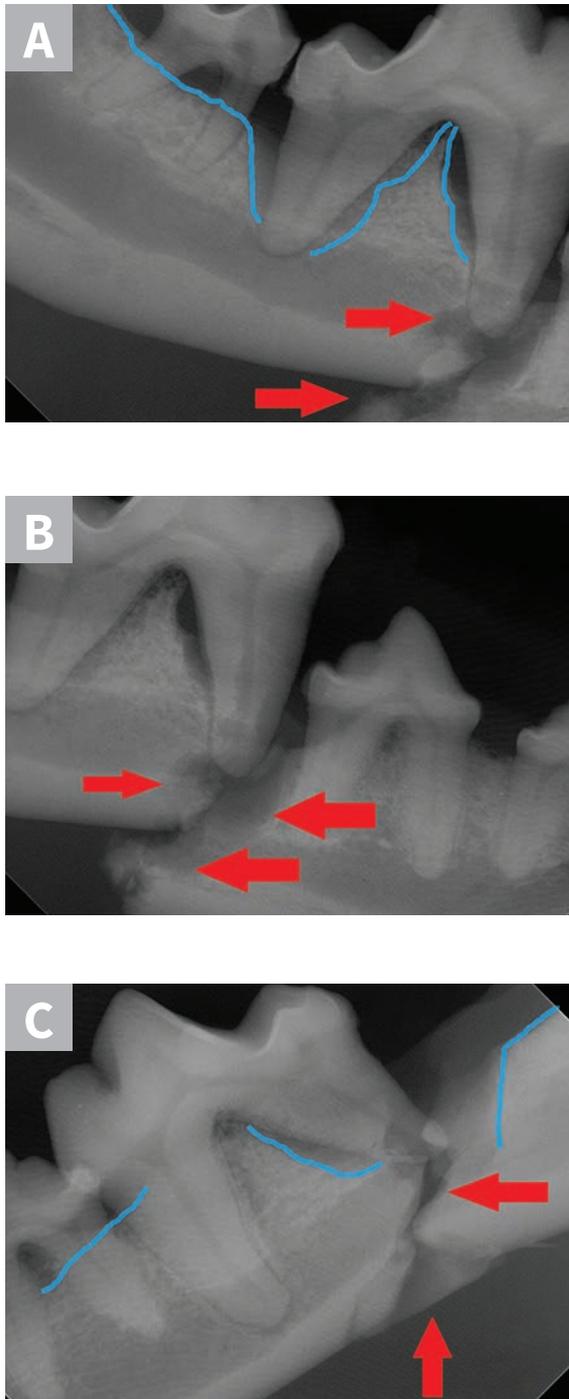
THE CASE

A 12-year-old, 7.9-lb (3.6-kg) neutered male miniature pinscher was emergently presented to a veterinary dental specialist following a dental cleaning at his primary veterinarian. During the dental cleaning, significant periodontal disease bilaterally involving the mandibular first molars had been noted on periodontal probing. Although dental radiography and equipment to section teeth were not available at the primary veterinarian's clinic, an attempt was made to extract the mobile teeth fully intact. However, both mandibles fractured at the level of the first molars, partially due to bone loss associated with severe periodontitis, and the patient was subsequently referred to the dental specialist.

Emergency Presentation

On presentation to the specialist, the patient had a ventrally deviated mandible due to bilateral fractures. Physical examination findings were otherwise unremarkable; all vital parameters, aside from a BCS of 4/5, were within normal range. The tongue was slightly hanging out of the mouth on the left, and slight drooling was noted from the commissures of the mouth. Oral examination was not possible in the conscious patient due to behavior.

Preoperative blood work was in reference range. An IV catheter was placed, the patient was premedicated with hydromorphone, and maropitant was administered.



▲ **FIGURE 1** Preoperative intraoral dental radiographs of the right (**A** and **B**) and left (**C**) mandibular first molars. There is marked alveolar bone loss secondary to periodontal disease (**blue lines**), as well as pathologic, iatrogenic mandibular fractures (**arrows**).

Anesthesia was induced with diazepam and propofol. The patient was intubated and maintained with sevoflurane (2%) and oxygen. Monitoring included body temperature, ECG, pulse oximetry, noninvasive blood pressure, and capnography. A balanced IV crystalloid solution was also administered.

Diagnostics

A complete oral examination confirmed stage 4 periodontal disease of numerous teeth (ie, first through fourth maxillary premolars, all maxillary molars, both maxillary canines, all remaining incisors). Dental radiographs confirmed bilateral mandibular fractures at the mesial root of the right mandibular first molar and distal root of the left mandibular first molar (**Figures 1** and **2**).

Treatment & Follow-Up

A regional anesthetic agent (0.5% bupivacaine [0.2 mL]) was injected where the mandibular nerve enters the mandibular canal (inferior alveolar nerve block). The affected teeth were surgically extracted to minimize distraction of the bones, the area was gently debrided, and each mandible was stabilized with a single intraosseous wire; the oral soft tissues were sutured in a simple interrupted pattern with 5-0 poliglecaprone-25 to completely cover the bone (**Figure 3**). This provided sufficient reduction of the fractures and adequate stability.

The patient recovered uneventfully and was discharged the same day with medication for pain management (ie, meloxicam, buprenorphine) and instructions for the owner to administer only soft foods.

The patient was presented 7 weeks later for a recheck oral examination under general anesthesia (performed in the same manner as previously). Dental radiographs demonstrated healing of the fractures (**Figure 4**, page 68). The interfragmentary wires were removed via an intraoral approach, and postoperative intraoral radiographs were obtained to confirm adequate healing (**Figure 5**, page 68). The patient recovered uneventfully.

Discussion

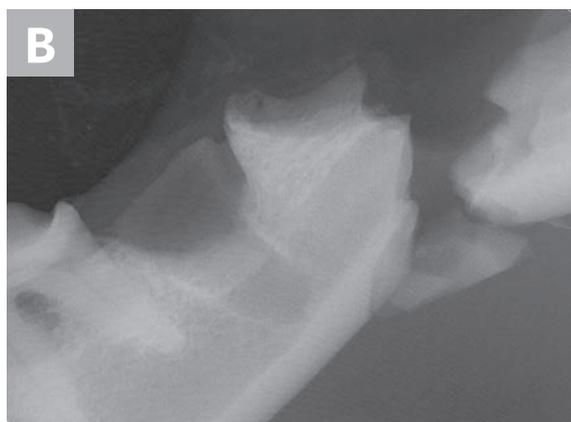
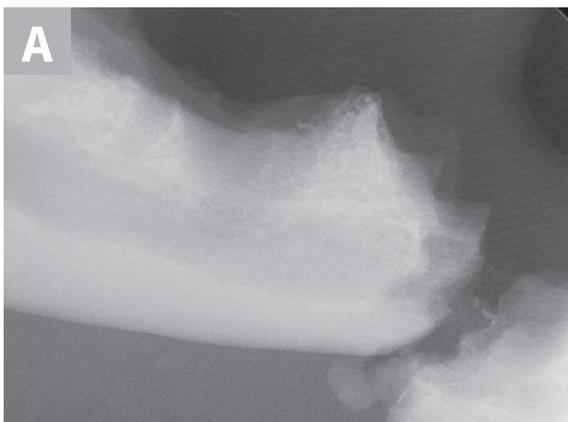
Pathologic jaw fracture is a significant local consequence of chronic periodontal disease.^{1,2} These fractures typically occur in the mandible due to chronic periodontal tissue loss, which weakens the bone in affected areas.³ Although these fractures can occur in any area of the mandible, they are especially common near the canine and first molar teeth.⁴ Pathologic jaw fractures are more common in small-breed dogs as compared with large-breed dogs due to their mandibular first molars being larger in proportion to the mandible itself.⁵ Small-breed dogs also have a minimal amount of bone apical to the tooth root, putting

this area at high risk for fracture when apical bone loss occurs.⁶

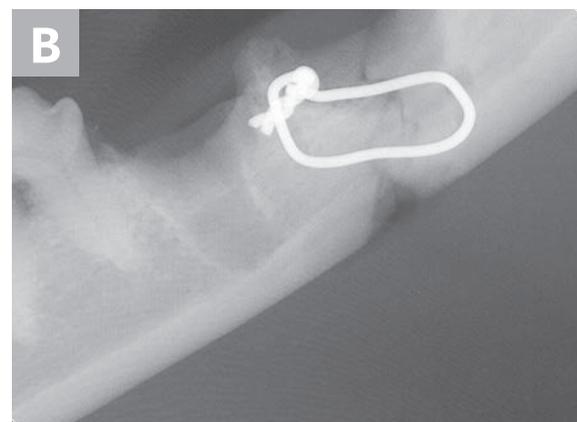
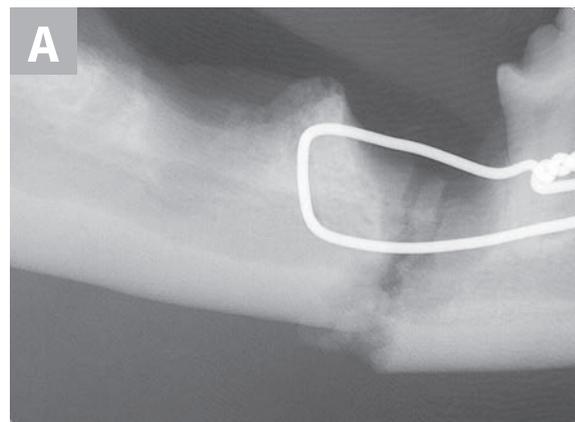
Pathologic jaw fractures have a guarded prognosis due to the lack of remaining bone and poor bone quality, presence of infection, low oxygen tension in the area of the fracture, and difficulty in rigid fixation of the caudal mandible.^{4,6} Regardless of the method of fixation used, diseased root(s) must be extracted to facilitate healing.^{3,7}

Pathologic jaw fractures typically occur as a result of mild trauma but can also occur during dental extraction procedures (ie, iatrogenic fracture).⁴

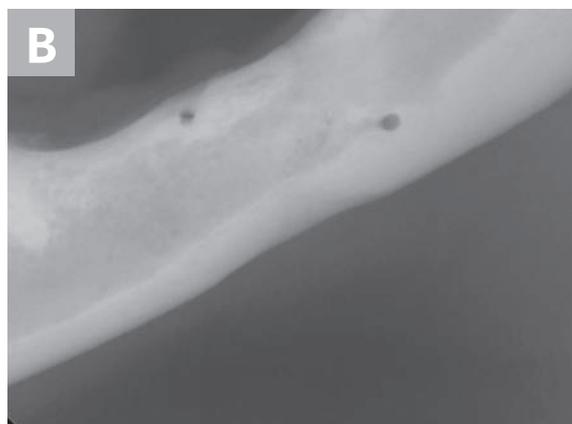
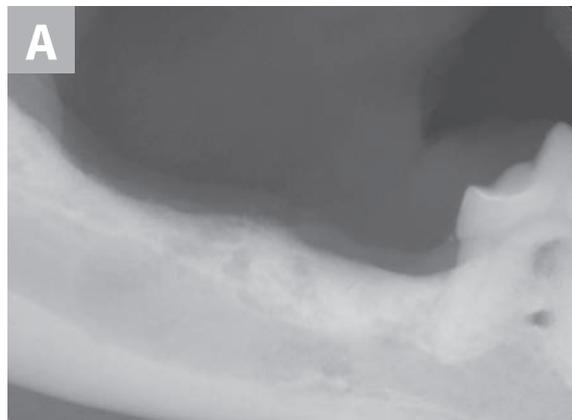
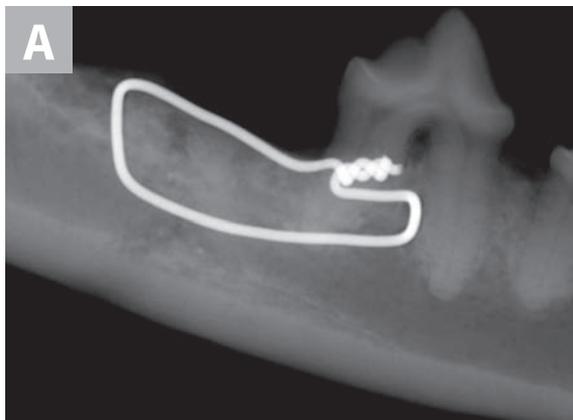
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▲ **FIGURE 2** Intraoperative intraoral dental radiographs of the right (**A**) and left (**B**) mandibles following extraction of the diseased teeth



▲ **FIGURE 3** Postoperative intraoral dental radiographs of the right (**A**) and left (**B**) mandible following reduction and fixation with a single intraosseous wire on each side.



▲ **FIGURE 4** Intraoral dental radiographs of the right (A) and left (B) mandible obtained at the 7-week recheck examination confirming adequate healing of the fractures, as well as bone regrowth at the extraction sites. Wire in the right mandible is placed between the roots of the fourth premolar to avoid trauma to the tooth.

▲ **FIGURE 5** Postoperative intraoral dental radiographs of the right (A) and left (B) mandible obtained at the 7-week follow-up examination after wire removal. Radiographs confirmed adequate healing of the fractures, as well as bone regrowth at the extraction sites.

Clinical awareness can help reduce risk for iatrogenic fractures during at-risk dental procedures.

Clinical awareness can help reduce risk for iatrogenic fractures during at-risk dental procedures (eg, extraction of the mandibular canines in dogs and cats, the mandibular first molars in small-breed dogs, the mandibular fourth premolars in small-breed brachycephalic animals, and teeth in any area weakened by infection or neoplasia).⁶

Dental radiography is critical to the proper care of dental patients, as radiography can help identify risk factors for jaw fracture (eg, alveolar bone loss).⁷ In cases in which severe alveolar bone loss is noted, particularly if the mandibular canine or first molar is affected, owners should be informed of the possibility of iatrogenic jaw fracture prior to extraction of the offending tooth.^{3,4}

Regardless of the degree of bone loss, diseased teeth with minimal remaining bone can be successfully extracted using proper technique.

Multirooted teeth should always be sectioned prior to extraction. This is important because roots of most multirooted teeth are divergent, and thus root tips will break if extractions are attempted in one piece.^{3,7-11} Root fracture can occur even if a tooth is relatively mobile. In addition, buccal bone removal may be performed if indicated, particularly if one of the roots or part of the root has significant periodontal attachment.⁸

This patient was successfully managed with a single interfragmentary wire on each side. This technique was elected because it was possible to achieve very good anatomic reduction of the fractures and provide clinically acceptable stability. However, when intraosseous wires are employed to fix fractures of the body of the mandible, it is important to ensure neutralization of bending forces with tension-band wire along the alveolar margin of the mandible and avoid tooth roots. A second area of fixation can also be considered at the ventral mandibular margin with a stabilization wire, which neutralizes rotational and shear forces. This will allow proper biomechanics for healing and prevent movement during the healing period.¹¹

Conclusion

Pet owners should be counseled about the importance of proper dental care to avoid the significant effects of periodontal disease. Further, dental radiography should always be performed prior to any extraction; it is particularly important to radiograph the mandible in small-breed dogs. Proper extraction techniques, including sectioning of multirooted teeth, should always be performed. Educating pet owners of the possibility of fracture is important from a legal aspect. In addition, patients with minimal apical bone should be referred to a veterinary dental specialist when possible.

Continues ►

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ASK YOURSELF ...

QUESTION 1

Why are small-breed dogs more prone to pathologic fractures?

- A. They are more aggressive chewers.
- B. They are more accident-prone.
- C. They have less calcium in their bones.
- D. Their teeth are larger in relation to their jaw size as compared with large-breed dogs.

CORRECT ANSWER: D

Because dogs weighing <11 lb (5 kg) have larger roots in relation to their mandible than do large-breed dogs and there is less bone apical to the tooth roots, smaller-breed dogs are at higher risk for fracture when apical bone loss occurs.

QUESTION 2

What must occur for a pathologic fracture to heal?

- A. Antibiotics must be prescribed.
- B. A bone plate must be used.
- C. Infected tooth roots in the fracture line must be extracted.
- D. A dental cleaning must be performed.

CORRECT ANSWER: C

Bone will not heal in the presence of infected tooth roots; therefore, infected tooth roots must be removed prior to fixation.

QUESTION 3

What steps can be taken to avoid iatrogenic fractures?

- A. Educating owners about the possibility of iatrogenic fracture in small dogs and ensuring that dental maintenance is performed
- B. Obtaining diagnostic dental radiographs prior to all extractions
- C. Referring patients to a veterinary dental specialist when minimal bone remains
- D. All of the above

CORRECT ANSWER: D

Because iatrogenic fractures cannot occur without attempted extraction, education and prevention are key to avoiding these issues. Dental radiographs can help demonstrate the degree of risk associated with extraction. In addition, veterinary dental specialists have specialized training and advanced equipment to successfully perform extractions.

QUESTION 4

What must always be performed for extraction of multi-rooted teeth?

- A. Sectioning
- B. Antibiotic coverage
- C. Creation of a surgical flap
- D. Buccal bone removal

CORRECT ANSWER: A

Because roots of most multirooted teeth are divergent, the root tips will break if extractions are attempted with teeth in one piece, even if the tooth is relatively mobile. Therefore, all multirooted teeth should be sectioned prior to elevation.

QUESTION 5

How many points of contact are generally recommended for a mandibular body fracture repair using intraosseous wires?

- A. 1
- B. 2
- C. 3
- D. 4

CORRECT ANSWER: B

When intraosseous wires are employed to fix mandibular body fractures, it is ideal to provide compression/fixation on both the tension and compression sides. This will allow proper biomechanics for healing and will prevent movement during the healing period. ■

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51 to 100 lb	1	272 mcg	227 mg	Brown

HEARTGARD Plus is recommended for dogs 6 weeks of age and older. For dogs over 100 lb use the appropriate combination of these chewables.

ADMINISTRATION: Remove only one chewable at a time from the foil-backed blister card. Return the card with the remaining chewables to its box to protect the product from light. Because most dogs find HEARTGARD Plus palatable, the product can be offered to the dog by hand. Alternatively, it may be added intact to a small amount of dog food. The chewable should be administered in a manner that encourages the dog to chew, rather than to swallow without chewing. Chewables may be broken into pieces and fed to dogs that normally swallow treats whole.

Care should be taken that the dog consumes the complete dose, and treated animals should be observed for a few minutes after administration to ensure that part of the dose is not lost or rejected. If it is suspected that any of the dose has been lost, redosing is recommended.

HEARTGARD Plus should be given at monthly intervals during the period of the year when mosquitoes (vectors), potentially carrying infective heartworm larvae, are active. The initial dose must be given within a month (30 days) after the dog's first exposure to mosquitoes. The final dose must be given within a month (30 days) after the dog's last exposure to mosquitoes.

When replacing another heartworm preventive product in a heartworm disease preventive program, the first dose of HEARTGARD Plus must be given within a month (30 days) of the last dose of the former medication.

If the interval between doses exceeds a month (30 days), the efficacy of ivermectin can be reduced. Therefore, for optimal performance, the chewable must be given once a month on or about the same day of the month. If treatment is delayed, whether by a few days or many, immediate treatment with HEARTGARD Plus and resumption of the recommended dosing regimen will minimize the opportunity for the development of adult heartworms.

Monthly treatment with HEARTGARD Plus also provides effective treatment and control of ascarids (*T. canis*, *T. leonina*) and hookworms (*A. caninum*, *U. stenocephala*, *A. braziliense*). Clients should be advised of measures to be taken to prevent reinfection with intestinal parasites.

EFFICACY: HEARTGARD Plus Chewables, given orally using the recommended dose and regimen, are effective against the tissue larval stage of *D. immitis* for a month (30 days) after infection and, as a result, prevent the development of the adult stage. HEARTGARD Plus Chewables are also effective against canine ascarids (*T. canis*, *T. leonina*) and hookworms (*A. caninum*, *U. stenocephala*, *A. braziliense*).

ACCEPTABILITY: In acceptability and field trials, HEARTGARD Plus was shown to be an acceptable oral dosage form that was consumed at first offering by the majority of dogs.

PRECAUTIONS: All dogs should be tested for existing heartworm infection before starting treatment with HEARTGARD Plus which is not effective against adult *D. immitis*. Infected dogs must be treated to remove adult heartworms and microfilariae before initiating a program with HEARTGARD Plus.

While some microfilariae may be killed by the ivermectin in HEARTGARD Plus at the recommended dose level, HEARTGARD Plus is not effective for microfilariae clearance. A mild hypersensitivity-type reaction, presumably due to dead or dying microfilariae and particularly involving a transient diarrhea, has been observed in clinical trials with ivermectin alone after treatment of some dogs that have circulating microfilariae.

Keep this and all drugs out of the reach of children.

In case of ingestion by humans, clients should be advised to contact a physician immediately. Physicians may contact a Poison Control Center for advice concerning cases of ingestion by humans.

Store between 68°F - 77°F (20°C - 25°C). Excursions between 59°F - 86°F (15°C - 30°C) are permitted. Protect product from light.

ADVERSE REACTIONS: In clinical field trials with HEARTGARD Plus, vomiting or diarrhea within 24 hours of dosing was rarely observed (1.1% of administered doses). The following adverse reactions have been reported following the use of HEARTGARD: Depression/lethargy, vomiting, anorexia, diarrhea, mydriasis, ataxia, staggering, convulsions and hypersalivation.

SAFETY: HEARTGARD Plus has been shown to be bioequivalent to HEARTGARD, with respect to the bioavailability of ivermectin. The dose regimens of HEARTGARD Plus and HEARTGARD are the same with regard to ivermectin (6 mcg/kg). Studies with ivermectin indicate that certain dogs of the Collie breed are more sensitive to the effects of ivermectin administered at elevated dose levels (more than 16 times the target use level) than dogs of other breeds. At elevated doses, sensitive dogs showed adverse reactions which included mydriasis, depression, ataxia, tremors, drooling, paresis, recumbency, excitability, stupor, coma and death. HEARTGARD demonstrated no signs of toxicity at 10 times the recommended dose (60 mcg/kg) in sensitive Collies. Results of these trials and bioequivalency studies, support the safety of HEARTGARD products in dogs, including Collies, when used as recommended.

HEARTGARD Plus has shown a wide margin of safety at the recommended dose level in dogs, including pregnant or breeding bitches, stud dogs and puppies aged 6 or more weeks. In clinical trials, many commonly used flea collars, dips, shampoos, anthelmintics, antibiotics, vaccines and steroid preparations have been administered with HEARTGARD Plus in a heartworm disease prevention program.

In one trial, where some pups had parvovirus, there was a marginal reduction in efficacy against intestinal nematodes, possibly due to a change in intestinal transit time.

HOW SUPPLIED: HEARTGARD Plus is available in three dosage strengths (See DOSAGE section) for dogs of different weights. Each strength comes in convenient cartons of 6 and 12 chewables.

For customer service, please contact Merial at 1-888-637-4251.

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QUIZ CORNER

QUIZ YOURSELF

on this issue's features

Quiz Corner is offered by the publisher for entertainment purposes only and does not apply toward CE credit. Questions are provided by editorial staff and are not subject to peer review.

- 1 PROCEDURES PRO PAGE 10**
- When collecting a wound culture swab, the swab should be _____.
- A. Swiped quickly and gently across the center of the wound bed
 - B. Rolled across the entire surface of the exposed wound area, working from center to edges, while pressure is applied to the swab
 - C. Lightly rubbed back and forth on the affected area for ≈5 seconds
 - D. Rubbed back and forth on the affected area for ≈5 seconds while pressure is applied to the swab

- 2 CASE IN POINT PAGE 22**
- Which of the following dog types has a reportedly higher occurrence of lung lobe torsion?
- A. Miniature breed
 - B. Brachycephalic
 - C. Narrow-chested
 - D. Deep-chested

- 3 IMAGE GALLERY PAGE 31**
- An effusion composed of which of the following would be categorized as a high-protein transudate?
- A. <2.5 g protein/dL and < 3×10^9 nucleated cells/L
 - B. ≥2.5 g protein/dL and < 3×10^9 nucleated cells/L
 - C. ≥2.5 g protein /dL and ≥ 3×10^9 nucleated cells/L
 - D. None of the above

- 4 CONSULT THE EXPERT PAGE 57**
- In dogs, where is hemangiosarcoma most commonly found?
- A. Bone marrow
 - B. Right atrium and/or auricle
 - C. Spleen
 - D. Skin or SC tissue

- 5 WSAVA DENTAL SERIES PAGE 65**
- Mandibular fractures due to chronic periodontal tissue loss are especially common in which area of the mouth?
- A. Near the canine and third incisor teeth
 - B. Near the canine and third premolar teeth
 - C. Near the canine and first molar teeth
 - D. At the mandibular symphysis

1: D 2: D 3: B 4: C 5: C
Answer Key:

AUTHORS ► CONTINUED FROM PAGE 3



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IMAGE GALLERY PAGE 31

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THE PROTECTION DOGS COME RUNNING FOR.

The only Real-Beef Chewable isn't just the #1 choice of dogs,¹ owners,² and veterinarians³ - it's the one dogs look forward to. HEARTGARD Plus:

- ✓ Protects dogs from heartworm disease and treats and controls 3 species of hookworms and two species of roundworms
- ✓ Is approved for puppies as young as 6 weeks of age
- ✓ Over 30 years of trusted prevention



¹ Freedom of Information: NADA140-971 (January 15, 1993).

² Data on file at Boehringer Ingelheim.

³ Data on file at Boehringer Ingelheim.

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IMPORTANT SAFETY INFORMATION: HEARTGARD[®] Plus (ivermectin/pyrantel) is well tolerated. All dogs should be tested for heartworm infection before starting a preventive program. Following the use of HEARTGARD Plus, digestive and neurological side effects have rarely been reported. For more information, please see full prescribing information or visit www.HEARTGARD.com.

See page 71 for product information summary.

