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*Hill’s data on file. Clinical study on microbiome changes in cats.
NUTRITIONAL MANAGEMENT OF DOGS WITH GI DISORDERS

GI DISORDERS | FAT SENSITIVE DISORDERS | FIBER-RESPONSIVE ENTEROPATHIES, ANTIBIOTIC-RESPONSIVE DIARRHEA, CONSTIPATION, DIARRHEA | FOOD-RESPONSIVE ENTEROPATHIES | ADVERSE FOOD REACTION

i/d | i/d Low Fat | i/d | i/d Sensitive | z/d

Suspected Stress Colitis

i/d Stress

NUTRITIONAL MANAGEMENT OF CATS WITH GI DISORDERS

GI DISORDERS | CONSTIPATION, FIBER-RESPONSIVE ENTEROPATHIES, ANTIBIOTIC-RESPONSIVE DIARRHEA, DIARRHEA, MEGACOLON | ADVERSE FOOD REACTION

i/d | z/d

Once AFR confirmed

z/d d/d

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1 Data on file.
2 Data on file.
3 Data on file.

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What is your first-line treatment choice for a large (>50% of the pinna) aural hematoma?

- 32% Medical
- 68% Surgical

How often does your clinic hold staff meetings?

- “We hold a monthly lunch meeting for all staff and an informal weekly meeting.”—Susan R
- “In addition to daily morning huddles and rounds, departments meet as needed, usually weekly, and there are monthly general staff and doctor meetings.”—Bruce F
- “Once or twice a year.”—Amanda N
- “Never.”—Alexis R
- “Every week; it is imperative.”—Jessie W
- “We have a 30-minute weekly meeting and a 5- to 10-minute huddle every morning.”—Leisa F

How long after graduation did you keep your class notes?

- “45 years, and I still have some of my anatomy and pharmacology notes.”—Pamela G
- “I burned all my equine notes directly after finals. Ah, bliss.”—Aaron B
- “5 years, and I still have most of them.”—Jessica M
- “I have been out of the field for almost 10 years, and I still have a lot of my notes and most of my books.”—Heather C
- “I still have my ophthalmology notes 11 years later. I tossed the others after 7 years.”—Jessica S

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JULIE ALLEN, BVMS, MS, MRCVS, DACVIM (SAIM), DACVP, is a former clinical assistant professor of clinical pathology at Cornell University. She earned her veterinary degree from University of Glasgow and her MS from Iowa State University, where she completed a rotating internship in small animal medicine and surgery and a residency in small animal internal medicine. She also completed a residency in clinical pathology at North Carolina State University. Dr. Allen focuses on cachexia/anorexia, endocrinology, and hepatobiliary and pancreatic disease and has committed her career to improving the diagnosis of disease.

Differential Diagnosis Page 17

JULIEN GUILLAUMIN, DVM, DACVECC, DECVECC, is an associate professor in the critical care unit at Colorado State University. He earned his DVM from National Veterinary School of Nantes in Nantes, France, and completed a small animal rotating internship at National Veterinary School of Alfort in Maisons-Alfort, France. Dr. Guillaumin completed a residency at University of California, Davis, and serves on the American College of Veterinary Emergency Critical Care residency training committee and the European College of Veterinary Emergency and Critical Care education committee. His clinical interests include hemostasis, blood banking and blood products, immune-mediated hemolytic anemia, thrombosis, systemic inflammatory response syndrome, sepsis, and multiple organ dysfunction syndrome.

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KELLEY THIEMAN MANKIN, DVM, MS, DACVS (Small Animal), is an assistant professor at Texas A&M University. Dr. Thieman earned her DVM from University of Missouri. She completed an internship at University of Tennessee and a residency at University of Florida. Her clinical interests include soft tissue surgery, reconstructive surgery, and oncologic surgery.

Procedures Pro Page 58

SUSAN PATERSON, VetMB, MA, DVD, DECVD, MRCVS, is the director of Virtual Vet Derms, the president of BSAVA, and the senior vice president of the European Society of Veterinary Dermatology. Dr. Paterson has published numerous books, book chapters, and articles and has lectured worldwide.

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April Summers, DVM, PhD
Julien Guillaumin, DVM, DACVECC, DECVECC

ON THE COVER

Case in Point
Vomiting & Diarrhea in a Lethargic Dog
April Summers, DVM, PhD
Julien Guillaumin, DVM, DACVECC, DECVECC

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NOTICE OF CORRECTION
In the Special Report “Alternatives to Opioids for Perianesthetic Analgesia Management” in the July 2018 issue of Clinician’s Brief, the dose for oromucosal dexmedetomidine was incorrectly stated. The oromucosal dexmedetomidine dose should have been listed as 125 µg/m². Clinician’s Brief regrets the error.

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SEMINTRA® (telmisartan oral solution) 10 mg/mL
For oral use in cats only
Angiotensin II Receptor Blocker
Brief Summary: Before using SEMINTRA, please consult the product insert, a summary of which follows:
Caution: Federal law restricts this drug to use by or on the order of a licensed veterinarian.
Description: SEMINTRA (telmisartan oral solution) is a clear, colorless to yellowish viscous solution containing 10 mg/mL telmisartan.
Indication and Usage: SEMINTRA is indicated for the control of systemic hypertension in cats. The initial dose of SEMINTRA is 1.5 mg/kg (0.68 mg/lb) orally twice daily for 14 days, followed by 2 mg/kg (0.91 mg/lb) orally once daily. The dose may be reduced by 0.5 mg/kg (0.23 mg/lb) increments to a minimum of 0.5 mg/kg (0.23 mg/lb) orally once daily to manage SEMINTRA-induced hypertension. SEMINTRA can be administered directly into the mouth, or next to or on top of a small amount of food. Do not mix into food.
SEMINTRA should be administered using the dosing syringe provided in the package. The dosing syringe fits onto the bottle and has 0.1 mL incremental marks. The dose should be rounded to the nearest 0.1 mL. After administration close the bottle tightly with the cap. Rinse the dosing syringe with water and let air dry.
If the cat vomits within 30 minutes of dosing, the cat may be re-dosed.
Information for Cat Owners: Adverse reactions can occur with use of SEMINTRA. The most common adverse reactions reported during the field studies included vomiting, diarrhea, lethargy, weight loss, anemia, and dehydration.
Contraindications: Do not use in cats with a hypersensitivity to telmisartan.
SEMINTRA is an angiotensin II antagonist/angiotensin receptor blocker (ARB). Pregnant women should avoid contact with SEMINTRA because substances that act on the renin-angiotensin-aldosterone system (RAAS) such as angiotensin receptor blockers (ARBs) can cause fetal and neonatal morbidity and death during pregnancy in humans.
Precautions: SEMINTRA can cause mild anemia or non-regenerative anemia. Cats should be monitored for anemia when initiating treatment with SEMINTRA. SEMINTRA may cause inappetence and weight loss in some cats. Cats should be monitored for weight loss when initiating treatment with SEMINTRA. Use with caution in cats with a history of vomiting, inappetence, or weight loss.
SEMINTRA has not been evaluated in cats with systolic blood pressure >200 mmHg.
The safe use of SEMINTRA in cats with hepatic disease has not been evaluated. SEMINTRA is metabolized by the liver.
The safe use of SEMINTRA has not been evaluated in cats less than 9 months of age, or in cats that are pregnant, lactating, or intended for breeding. See Human Warnings.
The safe use with other anti-hypertensive medications has not been evaluated.
Adverse Reactions: The safety of SEMINTRA was evaluated in a 28-day field study in 192 cats. Adverse reactions that occurred include vomiting 46 (24.0%), diarrhea 18 (9.4%), lethargy 13 (6.8%), weight loss 13 (6.8%), decreased appetite/inappetence 13 (6.8%), non-regenerative anemia 11 (5.7%), dehydration 10 (5.2%), retinal lesions (target organ damage) 4 (2.1%).
The long-term safety of SEMINTRA was evaluated in an open-label, 5-month field effectiveness and safety study in 107 cats that received at least one dose of SEMINTRA. Adverse reactions that occurred in this study were weight loss 37 (34.6%), vomiting 32 (30.9%), dehydration 16 (16.6%), non-regenerative anemia 17 (15.8%), anorexia 14 (13.1%), diarrhea 12 (11.2%), lethargy 12 (11.2%), decreased appetite/inappetence 11 (10.3%), heart murmur 10 (9.3%), death, euthanization, found dead 9 (8.4%), cough 8 (7.5%), and retinal lesions (target organ damage) 6 (5.6%).
Nine cats died or were euthanized during the study. Three cats had progressive chronic kidney disease that may have been affected by telmisartan treatment, concurrent disease, or inadequate control of hypertension. The other six cats died of causes unrelated to treatment (e.g. neoplasia).
To report suspected adverse drug events, for technical assistance, or to obtain a copy of the Safety Data Sheet (SDS), contact Boehringer Ingelheim Vetmedica, Inc. at 1-866-638-2228. For additional information about adverse drug experience reporting for animal drugs, contact FDA at 1-888-FDA-VETS or at http://www.fda.gov/AnimalVeterinary/SafetyHealth.
Effectiveness: Effectiveness was demonstrated in a 28-day multi-center, controlled, randomized and masked field study in client-owned cats with hypertension, and in an open-label 5-month field study.
28-Day Field Study
In a 28-day study, 288 cats with hypertension (systolic blood pressure [SBP] >160-200 mmHg) were enrolled in the study and randomized to treatment with SEMINTRA (telmisartan oral solution) (n=192) or vehicle control (n=96). The study population included cats with hypertension associated with chronic kidney disease or controlled hyperthyroidism, or idiopathic hypertension. The per protocol population for effectiveness was 141 SEMINTRA treated cats and 79 control cats. SEMINTRA was administered orally at 1.5 mg/kg twice daily for 14 days, then 2 mg/kg once daily until study end; the vehicle control was administered at a mL/kg volume equivalent to SEMINTRA. The two primary variables for effectiveness were comparison of the SEMINTRA and control group mean SBP (mSBP) from baseline to Day 14, and a decrease in mSBP >0 mmHg in the SEMINTRA group from baseline to Day 28. Cats with SBP >180 mmHg at Days 14 or 28 were rescued and removed from the study. There was a statistically significant difference between the mSBP for the SEMINTRA group compared to the control group at Day 14 (p<0.0001). At Day 14 the SEMINTRA group mSBP decreased by 23.2 mmHg, and the control group mSBP decreased by 7.3 mmHg. At Day 28, the SEMINTRA group mSBP decreased 23.9 mmHg compared to baseline.
5-Month Field Study
One hundred-seven cats from the SEMINTRA group that had successfully completed the 28-day study were enrolled in a 5-month open-label study. At the beginning of the 5-month study most cats were administered SEMINTRA at 2 mg/kg once daily. Cats that experienced hypertension (defined as SBP <120 mmHg) at 2 mg/kg once daily could have the SEMINTRA dose reduced to 1 mg/kg once daily. Cats that experienced hypertension at 1 mg/kg once daily could have the SEMINTRA dose reduced to 0.5 mg/kg once daily. Cats were evaluated for SBP, target organ damage (TOD; primarily assessed by retinal photographs), clinical pathology and adverse reactions. SBP was measured on Days 28, 56, 86, 140 and 182 and retinal photographs and clinical pathology were collected on Days 28, 56, 86 and 140.
Seventy-three (68.2%) cats completed the study (Day 182), 8 cats were removed for hypertension (SBP >180 mmHg), 2 cats were removed for hypotension, 10 cats were removed by the owner or for owner non-compliance, 3 cats were removed for new or worrisome TOD, and 6 cats were removed for adverse reactions unrelated to TOD. Twenty-six cats had dose reductions to 1 mg/kg once daily to manage hypertension. Of these 26 cats, 10 had an additional dose reduction to 0.5 mg/kg once daily.
NADA 141-501; Approved by FDA
Manufactured for:
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St. Joseph, MO 64506, U.S.A.
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Reference: Package Insert 449201-00 Revised 03/2013
09/2018

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OUR AUTHORS ▶ CONTINUED FROM PAGE 5

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M. KATHERINE TOLBERT, DVM, PhD, DACVIM (SAIM), is a clinical associate professor at Texas A&M University. Dr. Tolbert earned her DVM from University of Georgia, where she also completed a small animal internship. She earned her PhD in comparative biomedical sciences and completed an internal medicine residency at North Carolina State University. Her clinical research focuses on the investigation of gastroprotecants and the rationale for their use in the treatment of inflammatory, metabolic, and neoplastic diseases in small animals.

CASE IN POINT PAGE 31
Semintra® (telmisartan oral solution) is the first FDA-approved angiotensin receptor blocker for first-line treatment of cats with hypertension.

- Easy-to-use syringe allows for accurate dosing and flexible dosing.
- Safe for long-term administration, with once-daily dosing after 14 days.

IMPORTANT SAFETY INFORMATION

SEMINTA is an angiotensin II antagonist/angiotensin receptor blocker (ARB). Pregnant women should avoid contact with SEMINTRA because it can cause fetal and neonatal morbidity and death during pregnancy in humans. Pregnant women should avoid contact with SEMINTRA because other similar drugs have been found to harm the unborn baby during pregnancy. Precautions: SEMINTRA can cause mild anemia or non-regenerative anemia. Cats should be monitored for anemia when initiating treatment. Cats should be monitored for weight loss when initiating treatment with SEMINTRA. Use with caution in cats with a history of vomiting, inappetence, or weight loss. The safe use of SEMINTRA in cats with hepatic disease has not been evaluated. SEMINTRA is metabolized by the liver. SEMINTRA has not been evaluated in cats with systolic blood pressure > 200 mmHg. The safe use of SEMINTRA has not been evaluated in cats less than 9 months of age, or in cats that are pregnant, lactating, or intended for breeding. The safe use with other anti-hypertensive medications has not been evaluated.

For more information, please see full prescribing information on page 10.

References:

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OTITIS INVESTIGATION
Cytology

Bacilli identified on cytology with modified Wright’s stain

INVESTIGATION Suspected *P. aeruginosa* infection

Investigate primary (eg, allergy, endocrine disease, ectoparasites), predisposing (eg, conformation, swimming), and perpetuating (eg, otitis media, chronic change to ear anatomy) factors

Mild disease or first presentation

Severe or recurrent disease

TREATMENT Culture, flush, and begin first-line antimicrobial therapy pending culture and susceptibility results

INVESTIGATION Recheck in 10 days; conduct cytology and culture and susceptibility testing

Suspected *P. aeruginosa* infection

Eardrum ruptured?

- If integrity unclear, assume ruptured

TREATMENT Tris-EDTA + chlorhexidine (<0.2%) flush in combination with topical* ear drops for 10 days pending culture and susceptibility results. Use first-line topical licensed ear drops containing aminoglycosides (eg, gentamicin) or topical compounded silver sulfadiazine before second-line topical fluoroquinolones

INVESTIGATION Recheck in 10 days; conduct cytology and culture and susceptibility testing

Other bacilli (eg, *E. coli*) cultured

TREATMENT Treat based on culture and susceptibility results

NO

TREATMENT Flush ear with tris-EDTA to evaluate eardrum integrity

YES

INVESTIGATION Other bacilli (eg, *E. coli*) cultured

TREATMENT Tris-EDTA flush in combination with topical* antibacterial agents for 10 days pending culture and susceptibility results. Use extra-label aqueous solution of first-line antimicrobial (eg, gentamicin) before second-line topical fluoroquinolones

This article is an updated version of a previously published article from January 2016.
**INVESTIGATION**
Culture, flush, and begin first-line antimicrobial therapy pending culture and susceptibility results. Consider anti-inflammatory steroids if severe inflammation or stenosis is present.

**TREATMENT**
Flush ear with tris-EDTA to evaluate eardrum integrity. Consider flushing with patient under anesthesia for more effective removal of infectious material and better examination of the ear canal.

**INVESTIGATION**
Eardrum ruptured?
- If integrity unclear, assume ruptured

**NO**

**TREATMENT**
Flush to disrupt potential bacterial biofilm (e.g., N-acetylcysteine with tris-EDTA) before topical antimicrobial application.

**INTERMEDIATE TREATMENT**
If eardrum is not ruptured, flush with tris-EDTA + chlorhexidine (<0.2%) in combination with topical ear drops for 10 days pending culture and susceptibility results. Use first-line topical licensed ear drops containing aminoglycosides (e.g., gentamicin) or topical compounded silver sulfadiazine before second-line fluoroquinolones.

**YES**

**TREATMENT**
If eardrum is ruptured, flush with tris-EDTA in combination with topical antibacterial agent for 10 days pending culture and susceptibility results. Use extra-label aqueous solution of first-line antimicrobial (e.g., gentamicin) before second-line fluoroquinolones.

**INVESTIGATION**
Recheck in 10 days; conduct cytology and culture and susceptibility testing (see next page).

---

*Many topical drugs are ototoxic to the middle ear.*

EDTA = ethylenediaminetetraacetic acid
INVESTIGATION
Recheck in 10 days; conduct cytology and culture and susceptibility testing

INVESTIGATION
- P aeruginosa cultured
- Reassess with cytology

INVESTIGATION
Other bacilli (eg, E coli) cultured

TREATMENT
Continue with combination of flushes and topical antibacterial agent until negative cytology

INVESTIGATION
Not improving (ie, no change on cytology)

Switch antibacterial agent based on culture and susceptibility results, using tiered prioritization of drugs

Use tiered topical antibacterial agents as labeled or extra-label as needed:
- Tier 1: aminoglycosides (gentamicin, neomycin), compounded silver sulfadiazine
- Tier 2: fluoroquinolones, polymyxin
- Tier 3: compounded ticarcillin, amikacin, tobramycin, ceftazidime, piperacillin

Recheck in 10 days with cytology

INVESTIGATION
Not improving (ie, no change on cytology)

Chronic irreversible change may be present in ear canal or tympanic bulla; patient may be a candidate for advanced imaging and possible total ear canal ablation and bulla osteotomy

Suggested Reading
Nutritional Management of GI Disease in Dogs and Cats

Gastrointestinal disease is a common reason for veterinary consultation in both dogs and cats and causes significant stress to both the pet and owner.

These visits can range in severity from gastritis and constipation to more chronic conditions including colitis, pancreatitis, and inflammatory bowel diseases. The exact cause of the disease is not fully understood; however, imbalances in the gut microbiota and specific pathogens are considered major causes and/or consequences of the disease. Management of the condition is focused primarily on controlling the symptoms, eliminating the potential cause, and focusing on recovery of the gastrointestinal tract. Nutrition is essential in helping resolve and manage gastrointestinal issues. However, both pet owners and clinicians are inundated with nutritional information on the benefits of specific ingredients (e.g., prebiotics, probiotics, and dietary fiber). With the robust knowledge nutritionists have on individual ingredients, the approach should begin to extend beyond single ingredient validation to understanding how groups of ingredients work in synergy to optimize gut health and recovery.

There is growing evidence that the gut microbiome—a collection of microorganisms including bacteria, viruses, protozoa, and fungi residing throughout the gastrointestinal tract—plays a pivotal role in GI disease. We know that acute and chronic diarrhea patients have lower concentrations of certain beneficial bacteria that are important for producing the short-chain fatty acid metabolites essential for gut recovery and healing, and overall have a less diverse microbiome than healthy animals[1]. Furthermore, nutrition can play a role in combating this dysbiosis. Specifically, ingredients that provide sources of fiber and/or prebiotics have direct impacts on the gut microbiome opposite of observed changes in acute and chronic IBDs by promoting beneficial bacteria and short-chain fatty acid production.

To this end, dietary fibers and prebiotics are continually being evaluated for gut health as well as feasibility in diets.

References
2. Frantz NZ et al. Novel food with mixed soluble fiber promotes quicker resolution of acute diarrhea in shelter kittens. In: Proceedings of American College of Veterinary Internal Medicine (ACVIM); 2019, June 6-8; Phoenix, AZ.
3. Frantz NZ et al. Novel soluble fiber food promotes stool improvements and resolution of acute diarrhea in shelter puppies. In: Proceedings of American College of Veterinary Internal Medicine (ACVIM); 2019, June 6-8; Phoenix, AZ.
4. Frantz NZ et al. Novel food with mixed soluble fiber promotes improved stool scores in cats with chronic diarrhea. In: Proceedings of American College of Veterinary Internal Medicine (ACVIM); 2019, June 6-8; Phoenix, AZ.
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1. Frantz NZ et al. Novel food with mixed soluble fiber promotes quicker resolution of acute diarrhea in shelter kittens. In: Proceedings of American College of Veterinary Internal Medicine (ACVIM); 2019, June 6-8; Phoenix, AZ.
2. Frantz NZ et al. Novel soluble fiber food promotes stool improvements and resolution of acute diarrhea in shelter puppies. In: Proceedings of American College of Veterinary Internal Medicine (ACVIM), 2019, June 6-8; Phoenix, AZ.
Hypokalemia

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

Following are differential diagnoses, listed in order of likelihood, for patients presented with hypokalemia.

- **Increased loss**
  - Through the kidney (most common)
    - Chronic kidney disease
    - Loop and thiazide diuretics
    - Postobstructive diuresis (cats affected more than dogs)
    - Renal tubular disease
    - Osmotic diuresis
    - Acute metabolic acidosis secondary to lactic acid or ketone excretion
    - Primary metabolic alkalosis
    - Diuresis secondary to hyperadrenocorticism; some patients with adrenocortical tumors also produce excess aldosterone
    - High dietary sodium intake
    - Primary hyperaldosteronism, usually due to an adrenal tumor or hyperplasia
    - Excessive mineralocorticoid administration (eg, overdose of desoxycorticosterone pivalate or fludrocortisone)
    - Administration of certain drugs (eg, penicillins, carbonic anhydrase inhibitors, amphotericin B)
  - Through the GI tract
    - Vomiting
    - Chronic diarrhea
    - Ileus
  - Third-spacing (eg, loss in peritoneal fluid)

- **Transcellular shifts**
  - Insulin release or administration
  - Increased endogenous catecholamines (eg, pheochromocytoma) or epinephrine administration
  - Primary respiratory or metabolic alkalosis
  - Hyperthyroidism, likely due to transcellular shifts
  - Endotoxemia
  - Refeeding syndrome
  - Hypomagnesemia
  - Treatment with or toxicosis from β2 agonists (eg, albuterol, terbutaline)
  - Hyperinsulinemia secondary to xylitol toxicosis, which stimulates the activity of the Na+/K+-ATPase pump, which catalyzes transfer of potassium in the cells
  - Hypothermia
  - Hyperkalemic periodic paralysis (Burmese cats)

- **Decreased intake**
  - Administration of low-/no-potassium intravenous fluids
  - Low-potassium diets, often acidifying diets
  - Severe anorexia (usually a confounding factor and not a primary cause)
  - Ingestion of clay cat litter containing bentonite, which binds potassium in the GI tract

- **Pseudohypokalemia; occurs secondary to lipemia and marked hyperglobulinemia**

*Only when measured by indirect potentiometry, the method used by most chemistry analyzers; blood gas analyzers using direct potentiometry are unaffected.

See page 29 for references.
ProZinc®
(protemic zinc recombinant human insulin)

Caution: Federal law restricts this drug to use by or on the order of a licensed veterinarian.

Description: ProZinc® Insulin is a sterile aqueous protamine zinc suspension of recombinant human insulin.

Each mL contains:

recombinant human insulin 40 International Units (IU)
protamine sulfate 0.466 mg
zinc oxide 0.088 mg
glycine 1060 mg
dibasic sodium phosphate, heptahydrate 3.78 mg
phenol (added as preservative) 2.50 mg
hydrochloric acid 1.63 mg
water for injection (maximum) 1005 mg

pH is adjusted with hydrochloric acid and/or sodium hydroxide.

Indication: ProZinc (protemic zinc recombinant human insulin) is indicated for the reduction of hyperglycemia and hyperglycemia-associated clinical signs in cats with diabetes mellitus.

Dosage and Administration: USE OF A SYRINGE OTHER THAN A U-40 SYRINGE WILL RESULT IN INCORRECT DOSING.

For SUBCUTANEOUS INJECTION in CATS ONLY.

DO NOT SHAKE OR AGITATE THE VIAL.

ProZinc® insulin should be mixed by gently rolling the vial prior to withdrawing each dose from the vial. One mixed, ProZinc suspension has a white, cloudy appearance. Clumps or visible white crystals can form in insulin suspension; do not use the product if clumps or visible white particles persist after gently rolling the vial.

Using a U-40 insulin syringe, the injection should be administered subcutaneously on the back of the neck or the side of the cat. Always provide the Cat Owner Information Sheet with each prescription.

The initial recommended ProZinc dose is 0.1 – 0.3 IU insulin/pound of body weight (0.2 – 0.7 IU/kg) every 12 hours. The dose should be given concurrently with or right after a meal. The veterinarian should re-evaluate the cat at appropriate intervals and adjust the dose based on both clinical signs and glucose nadirs until adequate glycemic control has been attained. In the effectiveness field study, glycemic control was considered adequate if the glucose nadir from a 9-hour blood glucose curve was between 80 and 150 mg/dL and clinical signs of hyperglycemia such as polyuria, polydipsia, and weight loss were improved.

Further adjustments in the dosage may be necessary with changes in the cat’s diet, body weight, or concomitant medication, or if the cat develops concurrent infection, inflammation, neoplasia, or an additional endocrine or other medical disorder.

Contraindications: ProZinc insulin is contraindicated in cats sensitive to protamine zinc recombinant human insulin or any other ingredients in the ProZinc product.

ProZinc insulin is contraindicated during episodes of hypoglycemia.

Warnings: User Safety: For use in cats only. Keep out of the reach of children. Avoid contact with eyes. In case of contact, immediately flush with running water for at least 15 minutes. Accidental injection may cause hypoglycemia. In case of accidental injection, seek medical attention immediately. Exposure to product may induce a local or systemic allergic reaction in sensitized individuals.

Animal Safety: Overdose of insulin should be avoided and, if indicated, the dosage administered immediate. Any change in insulin should be made cautiously and only under a veterinarian’s supervision. Changes in insulin strength, manufacturer, type, species (human, animal) or method of manufacture (rDNA versus animal-source insulin) may result in the need for a change in dosage.

Appropriate diagnostic tests should be performed to rule out other endocrinopathies in diabetic cats that are difficult to regulate.

Precautions: Animals presenting with severe ketoacidosis, anorexia, lethargy, and/or vomiting should be stabilized with short-acting insulin and appropriate supportive therapy until the condition is stabilized. As with all insulin products, careful patient monitoring for hypoglycemia and hyperglycemia are essential to attain and maintain adequate glycemic control and to prevent associated complications. Overdose can result in profound hypoglycemia and death. Progestogens, certain endocrinopathies and glucocorticoids can have an antagonistic effect on insulin activity. Progestogens and glucocorticoiduse should be avoided.

Reproductive Safety: The safety and effectiveness of ProZinc insulin in breeding, pregnant, and lactating cats has not been evaluated.

Use in Kittens: The safety and effectiveness of ProZinc insulin in kittens has not been evaluated.

Adverse Reactions: Effectiveness Field Study

In a 45-day effectiveness field study, 178 cats received ProZinc insulin. Hypoglycemia (defined as a blood glucose value of < 50 mg/dL) occurred in 71 of the cats at various times throughout the study. Clinical signs of hypoglycemia were generally mild in nature (described as lethargic, sluggish, weak, trembling, uncoordinated, groggy, glassy-eyed or dazed). In 17 cases, the veterinarian provided oral glucose supplementation or treatment. Most cases were not associated with clinical signs and received no treatment. One cat had a serious hypoglycemic event associated with stupor, lateral recumbency, hypothermia and seizures.

All cases of hypoglycemia resolved with appropriate therapy and if needed, a dose reduction. Three cats had injection site reactions which were described as either small, punctate, red lesions; lesions on neck; or palpable subcutaneous thickening. All injection site reactions resolved without cessation of therapy.

Four cats developed diabetic neuropathy during the study as evidenced by plantigrade stance. These cats entered the study with plantigrade stance, one of which was euthanized on Day 45. Four cats were diagnosed with diabetic ketoacidosis during the study, two were euthanized due to poor response to treatment. Five other cats were euthanized during the study, one of which had hypoglycemia. Four cats had received ProZinc insulin for less than a week and were euthanized due to worsening concurrent medical conditions.

The following additional clinical observations or diagnoses were reported in cats during the effectiveness field study: vomiting, lethargy, diarrhea, cystitis/hematuria, upper respiratory infection, dry coat, hair loss, ocular discharge, abnormal vocalization, black stool, and rapid breathing.

Extended Use Field Study

Cats that completed the effectiveness study were enrolled into an extended use field study. In this study, 145 cats received ProZinc insulin for up to an additional 136 days.

Adverse reactions were similar to those reported during the 45-day effectiveness study and are listed in order of decreasing frequency: vomiting, hypoglycemia, anorexia/ poor appetite, diarrhea, lethargy, cystitis/hematuria, and weakness. Twenty cats had signs consistent with hypoglycemia described as: sluggish, lethargic, unrested, wobbly, seizures, trembling, or dazed. Most of these were treated by the owner or veterinarian with oral glucose supplementation or food; others received intravenous glucose.

One cat had a serious hypoglycemic event associated with seizures and blindness. The cat fully recovered after supportive therapy and finished the study. All cases of hypoglycemia resolved with appropriate therapy and if needed, a dose reduction.

Fourteen cats died or were euthanized during the extended use study. In two cases, continued use of insulin despite anorexia and signs of hypoglycemia contributed to the deaths. In one case, the owner decided not to continue therapy after a presumed episode of hypoglycemia. The rest were due to concurrent medical conditions or worsening of the diabetes mellitus.

To report suspected adverse reactions, or to obtain a copy of the Material Safety Data Sheet (MSDS), call 1-866-638-2226.

Information for Cat Owners: Please refer to the Cat Owner Information Sheet for more information about ProZinc insulin. ProZinc insulin, like other insulin products, is not from free from adverse reactions. Owners should be advised of the potential for adverse reactions and be informed of the associated clinical signs. Potential adverse reactions include: hypoglycemia, insulin antagonism/resistance, rapid insulin metabolism, insulin-induced hyperglycemia (Somogyi Effect), local or systemic reactions. The most common adverse reaction observed is hypoglycemia.

Signs may include: weakness, depression, behavioral changes, muscle twitching, and anxiety. In severe cases of hypoglycemia, seizures and coma can occur. Hypoglycemia can be fatal if an affected cat does not receive prompt treatment. Appropriate veterinary monitoring of blood glucose, adjustment of insulin dose and regimen as needed, and stabilization of diet and activity help minimize the risk of hypoglycemic episodes.

The attending veterinarian should evaluate other adverse reactions on a case-by-case basis to determine if an adjustment in therapy is appropriate, or if alternative therapy should be considered.

Effectiveness: A total of 187 client-owned cats were enrolled in a 45-day field study, with 176 receiving ProZinc insulin. One hundred and fifty-one cats were included in the effectiveness analysis. The patients included various purebred and mixed breed cats ranging in age from 3 to 19 years and in weight from 4.6 to 20.8 pounds. Of the cats included in the effectiveness analysis, 101 were castrated males, 49 were spayed females, and 1 was an intact female.

Cats were started on ProZinc insulin at a dose of 0.1-0.3 IU/kg (0.2-0.7 IU/lb) twice daily. Cats were evaluated at 7, 14, 30, and 45 days after initiation of therapy and the dose was adjusted based on clinical signs and results of 9-hour blood glucose curves on Days 7, 14, and 30.

Effectiveness was based on successful control of diabetes which was defined as improvement in at least one blood glucose variable (glucose curve mean, nadir, or fructosamine) and at least one clinical sign (polyuria, polydipsia, or body weight).

Based on this definition, 115 of 151 cases (76.2%) were considered successful. Blood glucose curve means decreased from 415.3 mg/dL on Day 0 to 203.2 mg/dL by Day 45 and the mean blood glucose nadir decreased from 407.9 mg/dL on Day 0 to 142.4 mg/dL on Day 45. Mean fructosamine values decreased from 505.9 μmol/L on Day 0 to 380.7 μmol/L on Day 45.

Cats that completed the effectiveness study were enrolled in an extended use field study. The mean fructosamine value was 342.0 μmol/L after a total of 181 days.

How Supplied: ProZinc® Insulin is supplied as a sterile injectable suspension in 10 mL multidose vials. Each mL of ProZinc product contains 40 IU recombinant human insulin.

Storage Conditions: Store in an upright position under refrigeration at 36-46°F (2-8°C). Do not freeze. Protect from light. Use within 60 days of first puncture.

Manufactured for: Boehringer Ingelheim Vetmedica, Inc.
St. Joseph, MO 64506 U.S.A.

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Backed by the largest prospective study in diabetic cats to date, PROZINC offers predictable glycemic control and efficacy proven to improve clinical signs associated with diabetes. Another study shows that remission rates with the use of PROZINC were comparable to glargine. Make PROZINC your first-line treatment for diabetic cats.

For more information, contact your Boehringer Ingelheim representative.

Important Safety Information for Cats: For use in cats and dogs only. Animals presenting with severe ketoacidosis, anorexia, lethargy, and/or vomiting should be stabilized with short-acting insulin and appropriate supportive therapy until their condition is stabilized. As with all insulin products, careful patient monitoring for hypoglycemia and hyperglycemia is essential to attain and maintain adequate glycemic control and to prevent associated complications. Overdosage can result in profound hypoglycemia and death. Progestogen and glucocorticoid use should be avoided. PROZINC insulin is contraindicated in cats during episodes of hypoglycemia and in cats sensitive to protamine zinc recombinant human insulin or any other ingredients in the PROZINC product.

For more information, please see full prescribing information for cats on page 18.

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Minutes Count: Traumatic Brain Injury

Traumatic brain injury (TBI) is most commonly the result of head trauma and can be caused by motor vehicle accidents, animal attacks, falls, blunt force, or crush injuries. Life-threatening extracranial injuries (eg, hemorrhage, pulmonary contusions, pneumothorax) should be prioritized, then intracranial injuries addressed.

Intracranial injuries can be primary or secondary. Primary brain injury occurs at the moment of trauma and is irreversible, whereas secondary brain injury occurs as a result of the primary injury and can occur minutes to days later. Physiologic consequences of secondary brain injury can include increased intracranial pressure, compromised blood-brain barrier, brain lesions, cerebral edema, infections, vasospasms, and seizures.

TBI is treated by optimizing cerebral perfusion pressure, ensuring adequate oxygen delivery to the brain, maintaining cerebral blood flow, and monitoring neurologic status. A therapeutic approach involves oxygen supplementation, volume expansion, minimum database collection, neurologic assessment, preservation of cerebral perfusion pressure, analgesia, and supportive care. Low-volume fluid therapy should be initiated with isotonic crystalloids to meet resuscitation endpoints. Systolic and mean arterial blood pressure should be kept at ≥100 mm Hg and ≥80 mm Hg, respectively, to maintain cerebral perfusion pressure. Venous blood gas measurement enables assessment of hemorrhage, ventilation, and perfusion status. Frequent neurologic assessments, including level of consciousness, breathing patterns, pupillary light reflex, posture, reflex, and coma scale (eg, modified Glasgow Coma Scale), should be performed to determine patient improvement or deterioration. Mannitol and hypertonic saline have osmotic effects and can help decrease intracranial pressure. Analgesia, anticonvulsants, and nutritional support are important adjunctive treatments. Use of corticosteroids is contraindicated. Thorough nursing care is an important component of success in TBI cases.—Waxman C

Picky Kitty: Feeding the Inappetent or Anorexic Cat

Inappetence is a common problem in cats. Cats’ ability to conserve body protein is limited, and they become less able to digest fat, protein, and micronutrients as they age; therefore, providing adequate nutrients while searching for the underlying cause is necessary.

The first step to addressing inappetence is to note food intake (ie, type, amount, frequency), BCS, MCS, and weight. Caloric requirements should then be calculated, and existing and ideal BCS should be taken into account. Owners should be given both verbal and written instructions regarding the type of food and how much to give. Weekly or biweekly reassessment is important. Dietary changes, if recommended, should be gradual and never made while the patient is hospitalized. Ensuring adequate food intake is generally more important than insisting on feeding the correct diet.

If body condition fails to improve, further intervention is required. Rehydration and appetite stimulants (eg, cyproheptadine, mirtazapine) are first-line treatments. When inappetence persists for >3 to 5 days, supportive feeding may be required. Syringe feeding, when done properly, can be successful short-term. Esophageal tubes generally are not complicated to place and are appropriate for longer-term feeding. Improved quality of life is the goal of nutritional support, despite whether full recovery is possible.—Scherk M
Navigating the Pharmacy: Improving Communication & Reducing Errors

Clinicians are responsible for diagnosing a patient and prescribing medication in the formulation most likely to be successfully administered. A valid clinician–owner–patient relationship must exist, and clinicians must provide clear prescriptions. Pharmacists must verify the accuracy and validity of prescriptions, including dosages and interactions, and must provide counsel on administration and monitoring to owners. There are several strategies to help streamline these processes and reduce prescription errors:

▶ Ideally, prescriptions should be typed and shorthand abbreviations should be avoided. Drug names should be spelled out when prescriptions are made over the phone. Writing “no substitutions” on prescriptions is also appropriate when concern for error exists.
▶ Owners should be informed of what medication to expect.
▶ Providing local pharmacies with copies of veterinary drug formularies and encouraging them to contact the clinician with concerns can help avoid confusion about dose and adverse effect discrepancies between humans and animals. Some resources offer sample letters to help establish lines of communication between clinicians and local pharmacists.1
▶ Being proactive in discussing drug costs and over-the-counter options with pet owners can help prevent well-intentioned but potentially disastrous substitutions at the pharmacy.
▶ Looking for websites with “.pharmacy” through the National Association of Boards of Pharmacy can help verify the safety of online pharmacies. Handouts on online medication safety can also be provided to pet owners.2—Boatright K, Eichstadt-Forsythe L

References

Behavior Essentials: Preventive Care for Puppies & Kittens

Undesirable behaviors are a common problem in young dogs and cats. Teaching young patients to be calm in a veterinary setting can help improve the quality of care they receive at home and at the clinic.

Behavior evaluations should be a part of all puppy and kitten examinations. All staff should promote a culture free of fear for patients. Use of treats can be coordinated with owners, and a variety of treats and toys should be available in examination rooms.

Extremely shy or fear-aggressive patients are unlikely to improve and tend to worsen; behavioral intervention is recommended, as these patients present a potential future welfare concern. Early intervention is particularly helpful in younger patients; antianxiety medications and behavioral therapy can be beneficial. Offering early puppy and kitten play groups at the clinic can help teach these young patients that the clinic is a nonthreatening environment.

Housetraining is also important to a pet’s welfare. Realistic expectations should be set for owners regarding the time it will take to accomplish housetraining, and owners should be educated on positive reinforcement and direct supervision. Kittens also need to be taught proper elimination habits. Low-sided, clean, and easily accessible litter boxes are important to proper elimination.

Destructive behaviors in puppies can be minimized by providing mental and physical stimulation. Because kittens and cats need to scratch, they should be provided with acceptable surfaces on which to do so; this may require patience to find what works for the individual cat.—Feyrecilde M

Owners should be educated on positive reinforcement and direct supervision.
Managing Anesthesia Recovery

In small animals, the postoperative period has the greatest risk for anesthetic-related death. Before the inhalant is discontinued, the oral cavity should be cleared of any residual debris and inspected for signs of regurgitation. The cuff should be deflated when the patient can swallow and protect its airway. Dogs should demonstrate multiple signs of regaining consciousness before extubation, whereas cats need only show the earliest signs of regaining consciousness, as prolonged extubation in cats can result in laryngospasm and airway obstruction. Extubation is often delayed in brachycephalic dogs and should be performed with the patient in sternal recumbency. Extubated patients should be assessed every 15 to 20 minutes, and the intravenous catheter should be maintained until full recovery. A heat source should be provided to patients with temperatures <99°F (37.2°C). Patients should be assessed for pain at least hourly throughout recovery.

Distinguishing whether a rough recovery is secondary to pain or anxiety can be challenging, so it is often best to treat patients experiencing a rough recovery with both an analgesic (eg, opioid agonist) and microdoses of a sedative/tranquilizer agent (eg, dexmedetomidine, acepromazine). Emergence delirium can occur when no sedative is administered during the recovery period; dysphoria is more likely to occur with excessively high opioid doses in nonpainful patients. Painful patients generally respond to analgesics and human interaction, whereas dysphoric patients do not. Partial reversal of pure opioids can be performed with butorphanol if sedatives are contraindicated and other pain control measures are implemented. Naloxone reversal should generally only be considered for opioid overdoses.—Palmer D
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Dr. Anthony Caiafa
BVSc BDSc MACVSc (SA Surgery and Veterinary Dentistry)
Disseminated intravascular coagulation (DIC) is a clinical syndrome that occurs as a complication of systemic disease and creates a hypercoagulable state, usually through crosstalk between inflammation and hemostasis. This activation of blood coagulation generates intravascular thrombin and fibrin, resulting in thrombosis of small-to-medium vessels, and can lead to multiorgan dysfunction syndrome if not appropriately controlled. Disseminated thrombus formation consumes platelets, clotting factors, and regulation factors (eg, antithrombin) and may progress to overt DIC. DIC can occur in several phases: a subclinical phase, an organ failure phase, and/or an overt (ie, bleeding) phase.

Thrombin, a product of hemostasis, exerts inflammatory mediation through the thrombin–thrombomodulin complex. Hemostasis is regulated by 3 antithrombotic systems, including antithrombin, which is most relevant to DIC pathogenesis. Antithrombin has important anticoagulant and anti-inflammatory effects, and its cofactor heparin makes it much more active. Although DIC can increase morbidity and mortality in affected patients, treating the underlying disease can generally control and reverse its physiologic consequences.

**Historical Findings & Clinical Signs**

There are no specific historical findings for DIC. In the overt phase, bleeding can be present, but subclinical DIC is also common. In cases of subclinical DIC, any history and clinical signs will be due to the primary disease that is causing DIC (eg, sepsis, immune-mediated hemolytic anemia, trauma, heat stroke; Table 1, next page).
Because of the association between inflammation and risk for development of DIC, clinicians should look for signs of systemic inflammatory response syndrome or sepsis, including tachycardia, tachypnea, increase in temperature, and signs of severe tissue trauma.

The DIC continuum is initiated by a prothrombotic, hypercoagulable condition. Clinical signs vary based on the phase. Affected patients may have no overt signs of DIC (e.g., bleeding, petechiae), have signs of organ dysfunction due to microthrombi, or may progress to a hypocoagulable bleeding phase, as clotting factors are consumed by the generalized activation of hemostasis that is central to the syndrome. Although DIC can be chronic and progress over several days, it can also be self-limiting and self-resolving and never progress to a bleeding phase.

### Diagnosis

Diagnosis of DIC can be challenging. DIC is a dynamic state of hemostasis imbalance that can result in concurrent hyper- and hypocoagulable states, depending on the organs affected. Scoring systems to determine the phase of DIC can be useful due to the absence of pathognomonic signs or laboratory abnormalities. Scoring systems also allow for a more objective characterization of the syndrome and can help identify patients with subclinical DIC, particularly for clinicians not expert in the disease; the more overt the signs of DIC are, the clearer the diagnosis. Several scoring systems have been developed and tested in both human and veterinary medicine.

The Wiinberg scoring system is a mathematical model that considers expert evaluations to be the gold standard. If a predisposing disease is present, clinicians can use this scoring system, which includes fibrinogen levels, d-dimer levels, prothrombin time (PT), and activated partial thromboplastin time (aPTT). In a study, the scoring system had a positive predictive value of 80% and a negative predictive value of 81%, therefore missing 20% of patients that experts believed had DIC. Thrombocytopenia or hypercoagulable thromboelastographic tracing can also be present in patients with DIC.

The ability of various scoring systems to predict mortality has also been investigated. A study has compared several scoring systems, including a modification of the International Society on Thrombosis and Haemostasis human DIC scoring system (Table 2), the Wiinberg scoring system, and results of individual hemostasis assays.

### Table 1

**Possible Causes of Disseminated Intravascular Coagulation**

<table>
<thead>
<tr>
<th>Type of Cause</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infectious inflammatory</td>
<td><strong>Bacterial</strong></td>
</tr>
<tr>
<td></td>
<td>• Severe localized infection</td>
</tr>
<tr>
<td></td>
<td>• Sepsis</td>
</tr>
<tr>
<td></td>
<td><strong>Viral</strong></td>
</tr>
<tr>
<td></td>
<td>• Canine parvovirus</td>
</tr>
<tr>
<td></td>
<td>• FIP</td>
</tr>
<tr>
<td></td>
<td><strong>Fungal</strong></td>
</tr>
<tr>
<td></td>
<td>• Fulminating systemic fungal disease</td>
</tr>
<tr>
<td>Noninfectious inflammatory</td>
<td><strong>Tissue trauma and/or ischemia</strong></td>
</tr>
<tr>
<td></td>
<td>• Gastric dilatation volvulus</td>
</tr>
<tr>
<td></td>
<td>• Pancreatitis</td>
</tr>
<tr>
<td></td>
<td>• Trauma</td>
</tr>
<tr>
<td></td>
<td>• Heatstroke</td>
</tr>
<tr>
<td></td>
<td>• Envenomation</td>
</tr>
<tr>
<td></td>
<td>• Successful cardiopulmonary resuscitation</td>
</tr>
<tr>
<td></td>
<td><strong>Immune-mediated causes</strong></td>
</tr>
<tr>
<td></td>
<td>• Immune-mediated hemolytic anemia</td>
</tr>
<tr>
<td></td>
<td><strong>Neoplasia</strong></td>
</tr>
<tr>
<td></td>
<td>• Hemangiosarcoma</td>
</tr>
<tr>
<td></td>
<td>• Acute leukemia</td>
</tr>
</tbody>
</table>

aPTT = activated partial thromboplastin time
DIC = disseminated intravascular coagulation
PT = prothrombin time
A 78% accuracy for mortality was identified when 3 of 6 individual hemostasis assays (ie, PT, aPTT, fibrinogen, antithrombin, d-dimer, platelet count) were outside the reference range; this was found to be a superior predictor of mortality as compared with previously reported scoring systems. Due to the limited availability of some diagnostic tests (eg, d-dimer) in practice, DIC may often be diagnosed based on the presence of a compatible primary disease (Table 1) and changes in classic hemostatic tests (Table 3).

**Treatment & Management**
Treatment of DIC can be complex and controversial. The only therapeutic approach recognized to be of benefit is treatment of the primary disease process (eg, administration of antibiotics and source control in septic patients).

---

### TABLE 2
HUMAN SCORING SYSTEM FOR DISSEMINATED INTRAVASCULAR COAGULATION*

<table>
<thead>
<tr>
<th>Points</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platelets ($\times 10^3/\mu L$)</td>
<td>&gt;100</td>
<td>&gt;50</td>
<td>&lt;50</td>
<td></td>
</tr>
<tr>
<td>d-dimers (ng/mL)</td>
<td>&lt;1000</td>
<td>1000-5000</td>
<td>&gt;5000</td>
<td></td>
</tr>
<tr>
<td>Fibrinogen (mg/dL)</td>
<td>&gt;100</td>
<td>&lt;100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prothrombin index†</td>
<td>&gt;70%</td>
<td>40%-70%</td>
<td>&lt;40%</td>
<td></td>
</tr>
</tbody>
</table>

*The human scoring system is presented as suggested by the International Society of Thrombosis and Haemostasis. Scores range from 0 to 8. A score ≥5 is compatible with overt DIC.
†Prothrombin index = $\left(\frac{PT \text{ control plasma}}{PT \text{ patient plasma}}\right) \times 100$

### TABLE 3
RECOMMENDED DIAGNOSTIC TESTS & TREATMENTS FOR PHASES OF DISSEMINATED INTRAVASCULAR COAGULATION²

<table>
<thead>
<tr>
<th></th>
<th>Subclinical Phase</th>
<th>Organ Failure Phase</th>
<th>Bleeding Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DIAGNOSTIC TEST</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PT</td>
<td>Normal</td>
<td>Normal</td>
<td>Increased</td>
</tr>
<tr>
<td>aPTT</td>
<td>Normal</td>
<td>May be slightly increased</td>
<td>Increased</td>
</tr>
<tr>
<td>Platelet count</td>
<td>Normal to slightly decreased (&gt;150,000/µL)</td>
<td>May be slightly decreased</td>
<td>Decreased</td>
</tr>
<tr>
<td><strong>TREATMENT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Of primary disease, if known</td>
<td>Recommended</td>
<td>Recommended</td>
<td>Recommended</td>
</tr>
<tr>
<td>With blood transfusion</td>
<td>No specific recommendation</td>
<td>No specific recommendation</td>
<td>Recommended</td>
</tr>
<tr>
<td>With heparin</td>
<td>Recommended</td>
<td>No specific recommendation</td>
<td>Not recommended</td>
</tr>
</tbody>
</table>
underlying disorder is properly managed, DIC may resolve spontaneously prior to development of overt clinical bleeding, although some cases may require supportive treatment aimed at the coagulation system (*Table 3*, previous page).²

Plasma therapy is recommended to correct active hemorrhage and/or for perioperative stabilization. Several guidelines and consensus statements in humans recommend administration of platelet concentrate and fresh frozen plasma (FFP) in DIC patients with active bleeding and in patients at high risk for bleeding that would require further invasive procedures.² FFP should not be used to correct abnormal coagulation parameters or increase antithrombin levels, as FFP contains only minimal antithrombin; however, FFP can replace other coagulation proteins that were consumed in the DIC process and may help control clinical signs of bleeding. An initial FFP dose of 15 mL/kg is recommended, although higher doses may be required.²

Although use of unfractionated heparin in the treatment of DIC is controversial in human medicine, most of the aforementioned guidelines recommend unfractionated heparin or low-molecular-weight heparin (LMWH) to treat subclinical DIC. Experimental studies have shown that heparin can partially inhibit the activation of coagulation in DIC,¹¹ but its impact on mortality or other clinically relevant outcomes in humans and veterinary patients is unknown. A low unfractionated heparin dose of 7-10 units/kg/hr has been shown to be safe in humans with sepsis-associated DIC,¹²,¹³ but these doses are much lower than the dose commonly recommended in veterinary medicine for thromboprophylaxis (150-300 units/kg SC q6-8h).¹⁴ LMWH can be used at doses of 0.8-1 mg/kg SC q6-8h for enoxaparin or 150 units/kg SC q8h for dalteparin.¹⁴ The impact of heparin therapy on the inhibition of the coagulation system in veterinary medicine is unclear, with conflicting results available in dogs.¹⁵,¹⁶

**Prognosis & Prevention**

Prognosis depends on the phase of the syndrome. Specific mortality rates for nonbleeding patients with DIC are lacking, but a recent study showed a 60% mortality rate in dogs with DIC in the bleeding phase.¹

Preventive measures may not be needed, as DIC can resolve spontaneously when the underlying disorder improves. However, the recommendation for nonbleeding humans with DIC is use of either unfractionated heparin or LMWH.²

**Clinical Follow-Up & Monitoring**

In DIC patients with diseases that predispose to DIC (*Table 1*, page 26), inflammatory signs (eg, temperature, heart rate, respiratory rate, leukocytes, band neutrophils) should be monitored. If inflammatory signs are improving and the patient is clinically improving, progression of DIC is generally halted. Similarly, laboratory data pertinent to DIC diagnosis (eg, PT, aPTT, d-dimer levels, platelet count) should be regularly (eg, daily) monitored. Because DIC is a dynamic process, changes can occur rapidly and clinical decisions may change if the syndrome progresses.

---

**Plasma therapy is recommended to correct active hemorrhage and/or for perioperative stabilization.**

\[ aPTT = \text{activated partial thromboplastin time} \]
\[ DIC = \text{disseminated intravascular coagulation} \]
\[ FFP = \text{fresh frozen plasma} \]
\[ LMWH = \text{low-molecular-weight heparin} \]
\[ PT = \text{prothrombin time} \]
References


References


Differential Diagnosis
Continued from page 17

References


Look for These Articles in Future Issues

Blood Glucose Monitoring in Patients with Diabetes Mellitus

Responsible Antimicrobial Use

Step-by-Step: Passing Urinary Catheters in Dogs

Puppy & Kitten Socialization

Top 5 Canine Biliary Tract Diseases
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Elevated BUN After Chemotherapy

M. Katherine Tolbert, DVM, PhD, DACVIM (SAIM)  
Texas A&M University

Romeo, an 11-year-old, 11.6-lb (5.3-kg), neutered male crossbreed dog, was presented for a recheck evaluation for urinary bladder transitional cell carcinoma. He had previously undergone chemotherapy (mitoxantrone [5 mg/m² IV q3wk]) for 4 months and definitive radiation therapy.

Romeo had a history of left cranial cruciate ligament rupture that had been conservatively and nonsurgically managed with deracoxib (1.4 mg/kg PO q24h) for the year prior to presentation for a bladder tumor; CBC and serum chemistry profile performed about a month between each visit were unremarkable (Table, next page). His owners reported no problems, and he had a normal appetite with no history of vomiting or diarrhea.

Physical Examination
On physical examination, Romeo was bright, alert, and responsive. The only remarkable findings were left pelvic limb lameness and medial buttress of the left stifle. No abnormalities were noted on fundic examination, no pain was elicited on abdominal palpation, and rectal examination was unremarkable, with normal stool consistency and color.

Diagnostic Findings
An increase in BUN and BUN:creatinine ratio levels was observed over ≈5 months prior to presentation for recheck evaluation. Because Romeo was able to tolerate deracoxib and had no outwardly detectable adverse effects from NSAID administration, his increased BUN was initially attributed to GI injury secondary to chemotherapy and radiation therapy, but no improvement was shown with omeprazole and sucralfate treatment following chemotherapy. Deracoxib was continued because of the severity of Romeo’s orthopedic disease and potential benefits of cyclooxygenase-2 inhibition in
the treatment of bladder carcinomas. Although Romeo was clinically healthy, his BUN levels continued to increase following cessation of radiation therapy and during the weeks in which chemotherapy was not administered. He was treated with sucralfate slurry (500 mg PO q8h) and omeprazole (1 mg/kg PO q12h) for 2 weeks, and CBC and serum chemistry profile were evaluated at regular intervals; however, his BUN and BUN:creatinine levels continued to increase. A video capsule endoscopy (VCE) was performed to investigate the possibility of subclinical GI bleeding and revealed multiple hemorrhages in the distal small intestine (Figure; see Treatment at a Glance). Treatment with deracoxib was discontinued after VCE was performed.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Reference Range</th>
<th>First Biannual Examination</th>
<th>Second Biannual Examination</th>
<th>Before Chemotherapy</th>
<th>After Chemotherapy</th>
<th>After Radiation Therapy</th>
<th>First PPI Therapy</th>
<th>Second PPI Therapy</th>
<th>Discontinuation of Deracoxib</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packed cell volume (%)</td>
<td>39-58</td>
<td>44</td>
<td>47</td>
<td>40</td>
<td>44</td>
<td>47</td>
<td>47</td>
<td>44</td>
<td>47</td>
</tr>
<tr>
<td>Platelet count (×10³/µL)</td>
<td>190-468</td>
<td>374</td>
<td>348</td>
<td>335</td>
<td>389</td>
<td>363</td>
<td>408</td>
<td>429</td>
<td>412</td>
</tr>
<tr>
<td>BUN (mg/dL)</td>
<td>6-26</td>
<td>18</td>
<td>17</td>
<td>17</td>
<td>33</td>
<td>39</td>
<td>41</td>
<td>59</td>
<td>26</td>
</tr>
<tr>
<td>Creatinine (mg/dL)</td>
<td>0.7-1.5</td>
<td>0.6</td>
<td>0.6</td>
<td>0.7</td>
<td>0.7</td>
<td>0.8</td>
<td>0.7</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>Phosphorous (mg/dL)</td>
<td>2.5-5.6</td>
<td>2.4</td>
<td>3.1</td>
<td>3.1</td>
<td>4</td>
<td>3.1</td>
<td>3.9</td>
<td>3.9</td>
<td>3.1</td>
</tr>
<tr>
<td>Calcium (mg/dL)</td>
<td>9.4-11.4</td>
<td>9.4</td>
<td>9.2</td>
<td>9.3</td>
<td>10</td>
<td>10.5</td>
<td>10.4</td>
<td>10.2</td>
<td>9.1</td>
</tr>
<tr>
<td>Total protein (g/dL)</td>
<td>5.2-7.3</td>
<td>5.5</td>
<td>5.7</td>
<td>5.7</td>
<td>5.9</td>
<td>6.4</td>
<td>6.1</td>
<td>6.2</td>
<td>6.1</td>
</tr>
<tr>
<td>Albumin (g/dL)</td>
<td>3-3.9</td>
<td>3.5</td>
<td>3.1</td>
<td>3.1</td>
<td>3.5</td>
<td>3.7</td>
<td>3.8</td>
<td>3.3</td>
<td>3.2</td>
</tr>
<tr>
<td>Sodium (mEq/L)</td>
<td>140-156</td>
<td>148</td>
<td>147</td>
<td>147</td>
<td>151</td>
<td>150</td>
<td>150</td>
<td>148</td>
<td>145</td>
</tr>
<tr>
<td>Potassium (mEq/L)</td>
<td>4-5.3</td>
<td>4</td>
<td>4.1</td>
<td>4.1</td>
<td>4.6</td>
<td>4.1</td>
<td>4.5</td>
<td>5</td>
<td>4.8</td>
</tr>
<tr>
<td>Chloride (mEq/L)</td>
<td>108-122</td>
<td>112</td>
<td>111</td>
<td>111</td>
<td>112</td>
<td>108</td>
<td>111</td>
<td>111</td>
<td>112</td>
</tr>
</tbody>
</table>
VCE has been used in dogs with unexplained causes of microcytosis, iron-deficiency anemia, or hypoalbuminemia to determine whether the cause was related to GI bleeding. VCE should be reserved for dogs weighing >9.5 lb (4.3 kg) because the size of the capsule restricts its use in smaller dogs. VCE is not recommended in cats, even those weighing >9 lb (4 kg), because of gastric retention of the capsule. The sensitivity of VCE for detection of the source of GI bleeding in dogs is unknown but is likely less than that of traditional endoscopy; thus, VCE should only be used when more sensitive measures for detection of GI bleeding are unavailable.

**DIAGNOSIS:**
**SUBCLINICAL GI BLEEDING**

**Treatment & Long-Term Management**
Omeprazole and sucralfate were continued; deracoxib was discontinued, and subsequent blood work revealed normalization of Romeo's BUN and serum BUN:creatinine levels. Mitoxantrone therapy was continued for the next year, and his BUN and BUN:creatinine levels remained within normal limits.

**Prognosis & Outcome**
At the 6-month follow-up after deracoxib was discontinued, Romeo had no evidence of GI bleeding and was still undergoing chemotherapy treatment for his bladder tumor. Because the GI bleeding was identified early and deracoxib was withdrawn, a good resolution is expected for Romeo’s NSAID-induced adverse effects.

**Discussion**
Adverse GI effects (eg, vomiting, diarrhea) are relatively common with NSAID administration in dogs, but less common adverse effects (eg, GI bleeding) may not always be detectable by the owner. Patients with multiple risk factors (eg, older dogs, dogs with comorbidities) are likely at increased risk. Early detection and treatment and, when possible, discontinuation of the NSAID can help ensure a good prognosis in dogs with NSAID-induced GI adverse effects (see *Take-Home Messages*, next page).

**TREATMENT AT A GLANCE**

- VCE is a noninvasive tool that can help confirm GI bleeding in dogs if traditional endoscopy is not available or if the dog is not a good anesthetic candidate.
- Fecal occult blood testing can increase the index of suspicion for GI bleeding in dogs but, because of associated low specificity, should not be used as a stand-alone test.
- The treatment of choice for NSAID-induced upper GI bleeding is proton-pump inhibitor (PPI; eg, omeprazole, esomeprazole, pantoprazole) therapy at 1 mg/kg PO or IV q12h. This class of drugs is superior to H₂-receptor antagonists (eg, famotidine, ranitidine) at equivalent doses in the treatment of GI ulceration in dogs.

**FIGURE** VCE confirming GI bleeding from multiple hemorrhagic areas (arrows) identified in the small intestinal mucosa
TAKE-HOME MESSAGES

- The most common NSAID-induced adverse effects in dogs are GI in origin.4
- Outwardly detectable adverse effects are not always present in dogs with NSAID-induced GI bleeding. Increased BUN and BUN:creatinine levels can be early indicators of subclinical GI bleeding and can occur in the absence of anemia.5
- Patients with multiple risk factors (eg, older dogs, dogs receiving ulcerogenic or erosive drugs, dogs with GI comorbidities such as inflammatory bowel disease) are at the highest risk for NSAID-induced GI bleeding.6 Dogs without other risk factors for GI bleeding that receive NSAIDs at appropriate doses, especially when used for short periods of time, rarely experience adverse effects.6 In the absence of additional risk factors for NSAID-induced GI injury, NSAIDs should be used alone. In the absence of other risk factors for GI bleeding, prophylactic PPI therapy with NSAID administration is not recommended because, although PPIs can help control GI bleeding in the stomach and proximal duodenum, the combination of NSAIDs with PPIs may worsen distal intestinal bleeding. This is thought to be secondary to alteration of the intestinal microbiota, increased intestinal permeability, and increased intestinal inflammation.3,7
- Discontinuation of NSAIDs and treatment with PPIs are recommended when possible for dogs presented with NSAID-induced clinical GI bleeding.

References
IMPORTANT SAFETY INFORMATION:

ENTYCE® (capromorelin oral solution) is for use in dogs only. Do not use in breeding, pregnant or lactating dogs. Use with caution in dogs with hepatic dysfunction or renal insufficiency. Adverse reactions in dogs may include diarrhea, vomiting, polydipsia, and hypersalivation. Should not be used in dogs that have a hypersensitivity to capromorelin. Please see the full Prescribing Information on page 34 for more detail.

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A Novel TPLO Plate That Provides Rotational Stability

The new Arthrex TPLO locking plate is designed with several new features that allow easier and more consistent plate placement and offer the option of a knotless anti-rotational lateral stabilization technique (InternalBrace™ ligament augmentation) in dogs with severe stifle instability.

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- New shape and additional features designed to facilitate optimal plate positioning
- Laser line assists in proper placement
Described 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.

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39 Refining ECG Lead Placement in Dogs
From the toughest cases to the most routine, this collection of concise clinical roadmaps from Clinician's Brief has you covered with succinct case management and differential diagnoses in an easy-to-follow format.

Add this handy clinical resource to your practice.
cliniciansbrief.com/algorithms
Research Note:  
**Effect of Prolonged Famotidine Administration in Cats**

Although proton-pump inhibitors are more effective acid suppressants as compared with H₂-receptor antagonists (eg, famotidine), famotidine remains widely used in veterinary medicine. In humans, dogs, and cows, decreased efficacy of famotidine has been demonstrated with prolonged administration. This study evaluated intragastric pH and serum gastrin concentrations with twice-daily administration (group 1) compared with twice-daily, every-second-day administration (group 2) of famotidine for 14 consecutive days in 16 healthy, adult research colony cats. Results indicate that, by day 13, tolerance developed in group 1 but not in group 2. Future studies on the effects of famotidine on gastric pH in cats with inflammatory, metabolic, and/or neoplastic diseases are indicated.

**Source**

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Research Note:  
**Refining ECG Lead Placement in Dogs**

ECG lead placement in dogs is important due to the variability of chest conformation and subsequent heart position. This study measured the accuracy of right atrial and ventricular depolarization based on precordial lead V₁ placement in dogs with different thoracic conformations. Patients were divided into 3 groups (ie, brachymorphic, mesomorphic, dolichomorphic), and 12-lead ECG recordings were taken with precordial lead V₁ in 5 different positions. Right atrial and ventricular depolarization readings varied greatly according to V₁ location. The most consistent readings for all 3 groups came from positioning V₁ at the costochondral junction of the right first intercostal space. This location should be evaluated as the standard for 12-lead ECGs in dogs.

**Source**
Acute Respiratory Distress Syndrome in Dogs & Cats

Amanda A. Cavanagh, DVM, DACVECC
Colorado State University

In the Literature

FROM THE PAGE …

Acute respiratory distress syndrome (ARDS) is a diffuse inflammatory lung injury that causes hypoxemia and often leads to death, even with intensive therapy. ARDS can be triggered by a primary lung problem (eg, pneumonia) or a systemic problem (eg, sepsis, trauma). Respiratory failure can also be accompanied by multiorgan dysfunction syndrome.

Five clinical criteria are used to diagnose ARDS in small animals; 4 of 5 must be met for a diagnosis:\n- Acute onset (<72 hours) of respiratory distress
- Presence of known risk factors (see Risk Factors for Acute Respiratory Distress Syndrome)

A FIGURE Thoracic CT images of bilateral, diffuse pulmonary infiltrates in a patient with severe trauma secondary to a gunshot wound sustained 24 hours prior to presentation. This patient met 4 criteria for a diagnosis of ARDS (ie, acute onset of respiratory distress, hypoxemia, bilateral diffuse pulmonary infiltrates, known risk factor for trauma).
Evidence of pulmonary capillary leak not due to heart failure or fluid overload (ie, bilateral, diffuse pulmonary infiltrates on thoracic radiographs or CT images)

Hypoxemia and impaired gas exchange (partial pressure of oxygen in the arteries [PaO₂]:fraction of supplemental oxygen [FiO₂] ratio ≤200 is indicative of ARDS)

Evidence of diffuse pulmonary inflammation in an airway sample (predominance of neutrophils and high-protein fluid)

There is no definitive treatment for ARDS. Precipitating causes should be aggressively addressed. Therapy should focus on respiratory support; most patients require prolonged mechanical ventilation. In addition, judicious fluid therapy to prevent volume overload and use of low tidal volumes during mechanical ventilation can help improve outcomes.²

In this study, medical records of 46 dogs and 8 cats were retrospectively evaluated to determine risk factors for ARDS development and patient outcomes. The most common risk factor identified in dogs was aspiration pneumonia, whereas systemic inflammatory response syndrome (SIRS) with or without apparent sepsis was most commonly identified in cats. Mechanical ventilation was recommended in 86% of patients; ventilation was not recommended in the remaining 14% of patients due to futile prognosis. The overall mortality rate was high (dogs, 84%; cats, 100%); however, many patients were euthanized shortly after diagnosis, potentially due to the financial burden associated with treating this syndrome.

RISK FACTORS FOR ACUTE RESPIRATORY DISTRESS SYNDROME³

- Inflammation
- Infection
- Sepsis
- SIRS
- Severe trauma
- Multiple blood transfusions
- Smoke inhalation
- Drowning or submersion injury
- Aspiration of gastric contents
- Drug overdoses, toxins, and toxic gases

... TO YOUR PATIENTS

Key pearls to put into practice:

1. Patients with suspected ARDS will be oxygen dependent. PaO₂:FiO₂ ratio should be used to diagnose hypoxemia in a patient receiving supplemental oxygen. When arterial blood gas measurement is obtained, PaO₂ should be divided by FiO₂. For example, a patient receiving 40% oxygen in an enclosure would have an FiO₂ of 0.4. A PaO₂:FiO₂ ratio ≤300 is suggestive of acute lung injury or a milder form of ARDS; ≤200 is suggestive of ARDS and severe lung injury.²

2. Aspiration pneumonia in dogs and SIRS in cats are the most common risk factors contributing to the development of ARDS.

3. Mechanical ventilation is an essential component of treatment of ARDS, which still carries a grave prognosis despite aggressive care.

References


Suggested Reading


FINDING UP-TO-DATE DRUG INFORMATION CAN BE TIME-CONSUMING.

PLUMB’S VETERINARY DRUGS CAN HELP.

Plumb’s isn’t just a book anymore—it’s a fast, convenient mobile app and digital platform, accessible exclusively at plumbsveterinarydrugs.com.
Proteinuria in Dogs

Lisbeth Rem Jessen, DVM, DECVIM-CA
University of Copenhagen
Copenhagen, Denmark

In the Literature

FROM THE PAGE …
Persistent proteinuria is a marker of chronic kidney disease and associated with increased risk for disease progression. Clinical relevance of proteinuria has been linked to its magnitude; in dogs with a urine protein:creatinine (UP:C) ratio persistently >0.5, further diagnostic investigation and treatment are recommended by the International Renal Interest Society.1 The urine dipstick test is a readily available diagnostic tool, but it is not considered reliable for quantitative estimation of proteinuria and results may be influenced by urine specific gravity (USG). UP:C is considered to be the most reliable method for urine protein quantification but may be elevated by presence of bacteria and inflammatory cells in the urine. This study addressed whether combining patient USG and dipstick protein results (ie, negative, trace, +1, +2, +3, +4) provides a reliable estimate of urine protein quantity, as combining these results may help clinicians determine when submission of UP:C is indicated. The study also sought to evaluate whether UP:C is affected by bacteriuria and whether elevation of UP:C correlates to bacterial load (colony forming units [CFU]/mL).

By examining medical records of 394 dogs (482 visits) with performed urinalyses, urine cultures, and UP:C, the researchers found only a weak correlation between UP:C and USG in each positive dipstick category; this demonstrates that the urine dipstick test is not a reliable tool for protein quantification, even when USG is considered. Dogs with a negative protein dipstick result were unlikely to have abnormal UP:C (>0.5) independent of USG. UP:C was negative (ie, ≤0.5) in 19 of 46 cases with positive urine cultures characterized by heavy growth (≥100,000 CFU/mL); there was only weak correlation between bacterial load and increased UP:C. The proportion of cases with active sediment was similar between proteinuric and nonproteinuric cases. These data indicate poor alignment between UP:C and positive urine culture results, thus challenging the perception that UP:C is automatically elevated in dogs with UTIs or subclinical bacteriuria.

… TO YOUR PATIENTS
Key pearls to put into practice:

1. The likelihood of abnormal UP:C (>0.5) is low in dogs with a negative protein urine dipstick result, regardless of USG.

2. Combining USG and positive dipstick protein category (trace, +1, +2, +3, +4) results does not provide a reliable estimate of protein quantity. Therefore, UP:C should be evaluated to assess the magnitude and relevance of proteinuria in dogs with a positive protein urine dipstick result.

3. UP:C can be normal in dogs with UTIs or subclinical bacteriuria; therefore, the presence of these conditions cannot explain abnormal UP:C. UP:C should be evaluated again after resolution of bacteriuria to assess whether further investigation is indicated.

Reference
For oral use in dogs only

20 mg, 60 mg and 100 mg flavored tablets

GALLIPRANT® (grapiprant tablets)

A prostaglandin E2 (PGE2) EP1 receptor antagonist, a non-cyclooxygenase inhibiting, non-steroidal anti-inflammatory drug

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

Before using GALLIPRANT, please consult the product insert, a summary of which follows:

Indication: GALLIPRANT (grapiprant tablets) is indicated for the control of pain and inflammation associated with osteoarthritis in dogs.

Dosage and Administration: Always provide “Information for Dog Owners” Sheet with prescription. Use the lowest effective dose for the shortest duration consistent with individual response.

The dose of GALLIPRANT (grapiprant tablets) is 0.9 mg/lb (2 mg/kg) once daily. Only the 20 mg and 60 mg tablets of GALLIPRANT are scored. The dosage should be calculated in half tablet increments. Dogs less than 8 lbs (3.6 kgs) cannot be accurately dosed. The 100 mg tablet is not scored and should not be broken in half. See product insert for complete dosing and administration information.

Contraindications: GALLIPRANT should not be used in dogs that have a hypersensitivity to grapiprant.

Warnings: Not for use in humans. Keep this and all medications out of reach of children and pets. Consult a physician in case of accidental ingestion by humans. For use in dogs only. Store GALLIPRANT out of reach of dogs and other pets in a secured location in order to prevent accidental ingestion or overdose.

Precautions: The safe use of GALLIPRANT has not been evaluated in dogs younger than 9 months of age and less than 8 lbs (3.6 kg), dogs used for breeding, or in pregnant or lactating dogs.

Adverse reactions in dogs receiving GALLIPRANT may include vomiting, diarrhea, decreased appetite, mucoid, watery or bloody stools, and decreases in serum albumin and total protein. If GALLIPRANT is used long term appropriate monitoring is recommended. Concurrent use with other anti-inflammatory drugs has not been studied. Concurrent use of GALLIPRANT with other anti-inflammatory drugs, such as COX-inhibiting NSAIDs or corticosteroids, should be avoided. If additional pain medication is needed after a daily dose of GALLIPRANT, a non-NSAID/ non-corticosteroid class of analgesic may be necessary. The concomitant use of protein-bound drugs with GALLIPRANT has not been studied. Commonly used protein-bound drugs include cardiac, anticonvulsant and behavioral medications.

Drug compatibility should be monitored in patients requiring adjunctive therapy. Consider appropriate washout times when switching from one anti-inflammatory to another or when switching from corticosteroids or COX-inhibiting NSAIDs to GALLIPRANT use.

The use of GALLIPRANT in dogs with cardiac disease has not been studied. It is not known whether dogs with a history of hypersensitivity to sulfonamide drugs will exhibit hypersensitivity to GALLIPRANT. GALLIPRANT is a methylbenzenesulfonamide.

Adverse Reactions: In a controlled field study, 285 dogs were evaluated for safety when using GALLIPRANT. Two hundred and eighty five (285) client-owned dogs were enrolled in the placebo-controlled, masked field study. Before using Galliprant, please consult the product insert, a summary of which follows:

**For dog owners:**

**Important Safety Information**

Not for use in humans. For use in dogs only. Keep this and all medications out of reach of children and pets. Store out of reach of dogs and other pets in a secured location in order to prevent accidental ingestion or overdose. Do not use in dogs that have a hypersensitivity to grapiprant.

If Galliprant is used long term, appropriate monitoring is recommended. Concomitant use of Galliprant with other anti-inflammatory drugs, such as COX-inhibiting NSAIDs or corticosteroids, should be avoided. Concurrent use with other anti-inflammatory drugs or protein-bound drugs has not been studied. The safe use of Galliprant has not been evaluated in dogs younger than 9 months of age and less than 8 lbs (3.6 kg), dogs used for breeding, pregnant or lactating dogs, or dogs with cardiac disease. The most common adverse reactions were vomiting, diarrhea, decreased appetite, and lethargy. Please see brief summary to the left for prescribing information.

**Adverse Reactions reported in the field study:**

**Table 1. Adverse reactions reported in the field study.**

<table>
<thead>
<tr>
<th>Adverse reaction*</th>
<th>GALLIPRANT (grapiprant tablets) N = 141</th>
<th>Vehicle control (tablets minus grapiprant) N = 144</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vomiting</td>
<td>24</td>
<td>9</td>
</tr>
<tr>
<td>Diarrhea, soft stool</td>
<td>17</td>
<td>13</td>
</tr>
<tr>
<td>Anorexia, inappetence</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Lethargy</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Buccal ulcer</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Immune mediated hemolytic anemia</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**IMPORTANT SAFETY INFORMATION**

Galliprant is an NSAID indicated for the control of pain and inflammation associated with osteoarthritis in dogs.

**Indication:**

Galliprant is an NSAID indicated for the control of pain and inflammation associated with osteoarthritis in dogs.

Information for Dog Owners:

- For additional information about adverse drug experience reporting for animal drugs, contact (SDS) or for technical assistance, call 1-888-545-5973.
- To report suspected adverse drug events and/or to obtain a copy of the Safety Data Sheet (SDS) or for technical assistance, call 1-888-545-5973.
- For more information about GALLIPRANT, see complete prescribing information in the product insert.
- Owners should be advised of the potential for adverse reactions and be informed of the clinical signs associated with drug intolerance. Adverse reactions may include vomiting, diarrhea, decreased appetite, mucoid, watery or bloody stools, and decreases in serum albumin and total protein. Appetite and stools should be monitored and owners should be advised to consult with their veterinarian if appetite decreases or stools become abnormal.
- **Effectiveness:** Two hundred and eighty five (285) client-owned dogs were enrolled in the study, and evaluated for field safety. GALLIPRANT-treated dogs ranging in age from 2 to 16.75 years. The proportion of dogs in the vehicle control group (41/131 or 31.3%) was compared to GALLIPRANT (63/131 or 48.1%) with a statistically significant difference in the proportion of treatment successes in the GALLIPRANT group (63/131 or 48.1%) was observed compared to the vehicle control group (41/131 or 31.3%), GALLIPRANT demonstrated a statistically significant difference in owner assessed pain and function. The results of the field study demonstrate that GALLIPRANT, administered at 2 mg/kg (0.9 mg/pound) once daily for 28 days, was effective for the control of pain and inflammation associated with osteoarthritis.
- **Storage Conditions:** Store at or below 86° F (30° C)
- **How Supplied:** 20 mg, 60 mg and 100 mg flavored tablets in 7, 30 and 90 count bottles

**Adverse Reactions:**

- Anorexia, inappetence 9 7
- Diarrhea, soft stool 17 13
- Buccal ulcer 1 0
- Immune mediated hemolytic anemia 1 0

* Dogs may have experienced more than one type or occurrence during the study.

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inhibiting, non-steroidal anti-inflammatory drug assessed for improvements in pain and function by the owners using the Canine Brief Pain total protein. Appetite and stools should be monitored and owners should be advised of the potential for adverse drug experiences when switching from corticosteroids or COX-inhibiting NSAIDs to GALLIPRANT use. Drug compatibility should be monitored in patients requiring adjunctive therapy. Commonly used protein-bound drugs include cardiac, anticonvulsant and behavioral drugs, such as COX-inhibiting NSAIDs and antibiotics, parasiticides and vaccinations. GALLIPRANT was used safely during the field studies with other concurrent therapies, including corticosteroids, should be avoided. If additional pain medication is needed after a daily dose of GALLIPRANT, a non-NSAID/ non-corticosteroid class of analgesic may be necessary.

The use of GALLIPRANT in dogs with cardiac disease has not been studied. If GALLIPRANT is used long term appropriate monitoring is recommended. If additional pain medication is needed after a daily dose of GALLIPRANT, a non-NSAID/ non-corticosteroid class of analgesic may be necessary. Concomitant use of GALLIPRANT with other anti-inflammatory drugs or protein-bound drugs has not been studied. Other anti-inflammatory drugs, such as COX-inhibiting NSAIDs and corticosteroids, should be avoided. If additional pain medication is needed after a daily dose of GALLIPRANT, a non-NSAID/ non-corticosteroid class of analgesic may be necessary.

Drug compatibility should be monitored in patients requiring adjunctive therapy. Commonly used protein-bound drugs include cardiac, anticonvulsant and behavioral drugs, such as COX-inhibiting NSAIDs and antibiotics, parasiticides and vaccinations. GALLIPRANT was used safely during the field studies with other concurrent therapies, including corticosteroids, should be avoided. If additional pain medication is needed after a daily dose of GALLIPRANT, a non-NSAID/ non-corticosteroid class of analgesic may be necessary.

Contraindications:

GALLIPRANT should not be used in dogs that have a hypersensitivity to the drug. Use the lowest effective dose for the shortest duration consistent with clinical improvement. Avoid gastro- intestinal effects before and after dosing. If GALLIPRANT is used long term appropriate monitoring is recommended. If additional pain medication is needed after a daily dose of GALLIPRANT, a non-NSAID/ non-corticosteroid class of analgesic may be necessary.

For use in dogs only. Not for use in humans. Keep this and all medications out of reach of children and pets. Store GALLIPRANT out of reach of dogs and other pets in a secured location in order to prevent accidental ingestion or overdose. Do not break tablets in half. Tablets of GALLIPRANT are scored. Dogs less than 8 lbs. (3.6 kgs) cannot be accurately dosed. The dosage of GALLIPRANT should be calculated in half tablet increments. The 100 mg tablet is not scored and should not be broken in half. See product insert for complete product information.

Dosage and Administration: Always provide “Information for Dog Owners” Sheet with GALLIPRANT. GALLIPRANT is indicated for the control of pain and inflammation associated with osteoarthritis in dogs. Before using GALLIPRANT, please consult the product insert, a summary of which follows:

Dosage: GALLIPRANT is given either GALLIPRANT or a vehicle control (tablet minus grapiprant) at a dose of 2 mg/kg given once daily. Dogs given GALLIPRANT in a field study had a disease severity of 2.5 or greater, a disease duration of 16.75 years. The following adverse reactions were observed:

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Feeding Practices & Food Puzzle Use

Deborah E. Linder, DVM, MS, DACVN
Cummings School of Veterinary Medicine at Tufts University

In the Literature

FROM THE PAGE …

In this study, 3192 cat owners were surveyed about what type of food they feed their cat, the method of delivery, and their attitudes toward and use of food puzzles. Most pet owners reported feeding dry food, of which >50% were feeding ad libitum. Only 30% of respondents used food puzzles; most (63%) of the food puzzle users noted that they had learned about them online or by seeing them in a pet store, whereas a smaller percentage learned about food puzzles through their primary veterinarian (13%), a veterinary behaviorist (9%), or a veterinary nurse (4%). Respondents who had stopped using food puzzles cited reasons such as their cat was “too lazy,” never figured them out, or did not benefit from using them. Owners who had never used food puzzles cited a variety of reasons for not doing so (eg, dogs in household, not wanting to attract bugs, having cats with different weight goals, lack of knowledge about food puzzles); this shows that there is an opportunity for clinicians to discuss overcoming barriers and potential benefits of enrichment.

Although the authors noted that more research is warranted to better determine the potential benefits of food puzzles for cats, food puzzles that can slow mealtimes and encourage activity and enrichment can be a creative tool in weight management and obesity prevention for indoor cats, as unlimited access to calories poses risks for obesity. Aligning owner expectations regarding weight management and obesity prevention is important, however; although increased activity with food puzzles can help with begging behaviors and maintain lean tissue and overall mental and physical health, there is no substitute for monitoring caloric intake. Informing owners that there is a variety of interactive toys available can help address many of the concerns mentioned in the survey (eg, cat being too lazy or not understanding the puzzle). Recommendations should be tailored to each family environment and the specific motivations of the cat; a list of ideas/activities and a troubleshooting guide can be helpful for owners who are not sure where to start or who may not initially see the value of enrichment for their cat (see Suggested Reading).
...TO YOUR PATIENTS

Key pearls to put into practice:

1. Considering that many of the respondents learned about food puzzles online or in pet stores, having visual displays or example food puzzles in clinic waiting rooms or examination rooms may help increase owner interest and awareness; these displays can then be incorporated into a larger discussion on feline wellness.

2. Every pet is unique. Recommendations should always be tailored to the specific motivations of each cat so it enjoys the activity; this can provide a bonding experience for the cat and its owner.

3. Owners should be educated to not use too many high-calorie treats to encourage use of a food puzzle. If an activity that burns 10 calories requires 100 calories in treats, it may be defeating the purpose of the enrichment.

4. Many resources are available for the veterinary staff that can help spark conversations with owners regarding food puzzles or additional enrichment; these resources can also be combined for an interactive list of activities to help inspire owners.

Suggested Reading


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- The rear drying rack heats air to 100°F (+/- 5°)
- Heat-fixes ear cytologies in 1 minute
- Dries smears in 30 seconds
- Dries rinsed slides in 1 minute
Seizure-Precipitating Factors in Epileptic Dogs

Erin Akin, DVM, DACVIM (Neurology)
Bush Veterinary Neurology Service
Woodstock, Georgia

In the Literature

FROM THE PAGE …

Epilepsy is the most common chronic neurologic disorder in dogs.1 Humans with epilepsy frequently report precipitating factors associated with their seizures, which are numerous and varied and have included stress, difficulty sleeping, infectious disease, hormonal factors, and missing medication, among others.2 In dogs, estrus has a reported association with cluster seizures, with intact female dogs clustering during estrus and for 1 to 3 months after.3 Other potential seizure-precipitating factors in canine epileptics include visits to the veterinary clinic, groomer, and/or boarding facility.4

In this study, 50 owners of dogs with idiopathic epilepsy were surveyed via an open-ended question followed by a checklist to identify seizure-precipitating factors and their prevalence in canine epileptics. When asked the open-ended question, 58% of owners reported at least one seizure-precipitating factor; stress, excitement, and hot weather were most frequently identified through this method. When selecting from the checklist, however, 74% of owners recognized at least one seizure-precipitating factor. The number of factors identified ranged from 1 to 9 per dog and included visitors to the home, altered sleep patterns, unfamiliar places, changes in lifestyle or routine, and weather. No owner reported vaccinations or dog shows as a precipitating factor.

A seizure occurred during or immediately following the precipitating factor in 19% of dogs with an identified precipitating factor, within 24 hours of the precipitating factor in 35%, and within 48 hours of the precipitating factor in 4%. In 11% of dogs, the precipitating factor only affected seizure frequency. Most dogs had both precipitated and unprompted seizures. Dogs with focal seizures had more precipitating factors identified than those with generalized seizures.

References

FROM PAGE TO PATIENT

TO YOUR PATIENTS
Key pearls to put into practice:

1. Seizure-precipitating factors are common in dogs with epilepsy and most commonly include stressful situations, lifestyle changes, and alterations in sleep patterns.

2. When treating a dog diagnosed with epilepsy, clinicians should discuss seizure-precipitating factors with the owner. Attempts to minimize these factors should be attempted when possible to achieve better treatment outcomes.

3. Precipitating factors do not always immediately precede a seizure; the seizure may follow within 24 to 48 hours after the precipitating factor. Thus, hospitalizing a patient for a minimum of 24 seizure-free hours may be beneficial.

Knowledge regarding the relationship between epileptic seizures and seizure-precipitating factors in canine epileptics is limited. Further studies are needed to identify seizure-precipitating factors, their prevalence, and their influence on seizures in epileptic dogs.
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Actinic & Nonactinic Dermal Squamous Cell Carcinoma in Dogs

Kate Vickery, VMD, MS, DACVIM (Oncology)
Hope Veterinary Specialists
Malvern, Pennsylvania

In the Literature

FROM THE PAGE …

Dermal squamous cell carcinomas (SCCs) are common skin tumors encountered in the clinic; however, large studies exploring the clinical features, behavior, and outcome of dogs with these tumors are lacking. Dermal SCCs occur in breeds with a nonpigmented, thin haircoat (eg, bull terriers, boxers, beagles, dalmatians, whippets), and many dermal SCC cases are related to sun exposure; tumors in these cases are referred to as actinic SCCs. Actinic SCCs are often located in regions of the body with a thin haircoat and high exposure to the sun (ie, ventrum, head, inguinal region).

In this retrospective study, records of 193 dogs presented with dermal tumors to a university teaching hospital over a 30-year period were evaluated. Excluded from the study population were dogs with tumors involving the digit, oronasal, intrathoracic, and/or intra-abdominal sites. Differences in signalment, tumor location, and outcome of dogs with actinic SCC as compared with dogs with SCC without actinic changes were identified. Dogs with actinic SCC were found to be significantly younger and more likely to have multiple tumors; they were also significantly more likely to be of a predisposed breed, have a predisposed coat color, and have tumors in a predisposed location. In contrast, dogs with tumors lacking features of actinic change had a shorter survival time and higher risk for metastasis to the lungs and regional lymph nodes. Breeds overrepresented in this group included golden retrievers, German shepherd dogs, and Labrador retrievers. The 3 most common tumor locations for SCC without actinic change included the periarticular, ventral cervical, and perianal regions.

This study demonstrates that there are 2 clinically distinct groups of dermal SCC: actinic SCC, in which dogs experience a less aggressive clinical course of disease, and SCC without actinic change, in which dogs are at higher risk for an aggressive clinical course of disease. An understanding of these 2 distinct clinical groups can help clinicians make recommendations for an appropriate diagnostic investigation and counsel the owner on the patient’s prognosis.
TO YOUR PATIENTS

Key pearls to put into practice:

1. Two major clinical presentations may be seen in dogs with dermal SCC, with differing clinical courses and outcomes in each group.

2. Dogs at risk for development of actinic SCC often have nonpigmented skin and a light coat color, are younger, and/or have multiple tumors. The clinical course of this disease is typically less aggressive, and surgery alone can provide long-term control.

3. Dogs with SCC without actinic change often experience an aggressive clinical course and have a high risk for metastasis and shorter survival times; tumors tend to be located in the periarticular, ventral cervical, and perianal regions. Over-represented breeds include golden retrievers, German shepherd dogs, and Labrador retrievers.

References


Did you hear the one about the veterinarian who thought ordering a compounded medication from a 503A pharmacy was the same as from a 503B pharmacy?

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The FDA Commissioner has stated that all hospitals should order compounded medication from an FDA Registered 503B Outsourcing Facility.
Elbow Incongruity

Jonathan Miller, DVM, MS, DACVS
Oradell Animal Hospital
Paramus, New Jersey

In the Literature

FROM THE PAGE …

Incongruity between the radius and ulna, the radius and humerus, and/or the ulna and humerus can be important components of elbow pain and subsequent dysplasia. A short radius increases pressure on the coronoid process of the ulna and can lead to fragmentation, which can be diagnosed via radiography or CT. Rotation between the humerus and ulna during weight-bearing can also increase pressure on the coronoid process.

In this systematic review, the authors summarize the current knowledge on elbow incongruity and its assessment. When radiographic signs of both radioulnar and humeroulnar incongruity were used for assessment, radiography yielded an 88.8% sensitivity and 91.7% specificity for diagnosis of elbow incongruity. Arthroscopy has also been shown to be useful for diagnosis; several studies have found sensitivity using this modality to be 94% to 98% and specificity to be 81% to 89%. MRI and joint ultrasonography, however, were not found to be as useful in the evaluation of elbow incongruity. The gold standard for diagnosis is CT with 1-mm slice thickness.

… TO YOUR PATIENTS
Key pearls to put into practice:

1. When evaluating dogs for lameness in the elbow joint, it is important to consider that elbow incongruity may be a contributing cause of lameness.
2. Mediolateral extended radiography and arthroscopic measurement of the joint space can aid in the evaluation of the elbow joint, but CT with 1-mm slice thickness is the gold standard for diagnosis of elbow incongruity.
3. Although there are 2 techniques (ie, proximal abducting ulnar osteotomy, biceps ulnar releasing procedure) to help relieve higher loading on the medial side of the elbow, these techniques have not been proven to be beneficial in dogs long-term, and there is no known best treatment for elbow incongruity.
IMPORTANT SAFETY INFORMATION: METACAM (meloxicam oral suspension) and PREVICOX (fi rocoxib) are for use in dogs only. METACAM (meloxicam) Solution for Injection is approved for use in dogs or cats. Repeated use of meloxicam in cats has been associated with acute renal failure and death. Do not administer additional injectable or oral meloxicam to cats. As a class, cyclooxygenase inhibitory NSAIDs like METACAM and PREVICOX may be associated with gastrointestinal, kidney, or liver side effects. Dogs should be evaluated for pre-existing conditions and currently prescribed medications prior to treatment with METACAM or PREVICOX, then monitored regularly while on therapy. Concurrent use with another NSAID, corticosteroid, or nephrotoxic medication should be avoided or monitored closely. For more information on products mentioned in this ad, please see full prescribing information on pages 56 and 57.
Metacam® (meloxicam oral suspension)

Description: Meloxicam is a non-steroidal anti-inflammatory drug (NSAID) of the oxicam class. Each milliliter of Metacam Oral Suspension contains meloxicam equivalent to 0.5 or 1.5 milligrams and sodium benzoate (1.5 milligram). The chemical name for Meloxicam is 5-methyl-2-thiazolyl)- 2H-1,2-benzothiazine-3-carboxamide-1, 1-dioxide. The formulation is a yellowish viscous suspension with the odor of honey.

Indications: Metacam Oral Suspension is indicated for the control of pain and inflammation associated with osteoarthritis in dogs.

Contraindications: Dogs with known hypersensitivity to meloxicam should not receive Metacam Oral Suspension.

Warnings: Do not use Metacam Oral Suspension in cats. Acute renal failure and death have been associated with the use of meloxicam in cats.

Precautions: The safe use of Metacam Oral Suspension in dogs younger than 6 months of age, dogs used for breeding, or in pregnant or lactating dogs has not been evaluated. Meloxicam is not recommended for use in dogs with bleeding disorders, as safety has not been established in dogs with these conditions. Safety has not been established for intramuscular (IM) administration in dogs. When administering Metacam 5 mg/mL Solution for Injection, use a syringe of appropriate size to ensure precise dosing. Metacam is contraindicated in dogs with blood dyscrasias, as safety has not been established in dogs with blood dyscrasias. Sensitivity to drug-associated adverse events varies with the individual patient. Dogs that have experienced adverse reactions from one NSAID may experience adverse reactions from another NSAID. Patients at greatest risk for renal toxicity are those that are dehydrated, on concomitant diuretic therapy, or those with existing renal, cardiovascular, and/or hepatic dysfunction. Concurrent administration of potentially nephrotoxic drugs should be carefully avoided. NSAIDs may inhibit the prostaglandin pathway and maintenance of normal homeostatic function. Such anti-prostaglandin effects may result in clinically significant disease in patients with underlying or pre-existing disease that has not been previously diagnosed. Since NSAIDs possess the potential to induce gastrointestinal ulcerations and/or perforations, concomitant use with other anti-inflammatory drugs, such as NSAIDs or corticosteroids, should be avoided. If additional pain medication is needed after administration of the total daily dose of Metacam Oral Suspension, a non-NSAID or non-corticosteroid class of analgesia should be considered. The use of another NSAID is not recommended. Consider appropriate washout times when switching from corticosteroid use or from one NSAID to another in dogs. The use of concurrent protein-bound drugs may affect the pharmacokinetics of Metacam Oral Suspension. Commonly used protein-bound drugs include cardiac, anticonvulsant and behavioral medications. The influence of concomitant drugs that may inhibit metabolism of Metacam Oral Suspension has not been evaluated. Drug compatibility should be monitored in patients requiring adjunctive therapy.

Adverse Reactions: Field safety was evaluated in 306 dogs. Based on the results of two studies, GI abnormalities (vomiting, soft stools, diarrhea, and inappetence) were the most common adverse reactions associated with the administration of meloxicam.

The following adverse events are based on post-approval adverse drug experience reporting. Not all adverse events have been evaluated. Drug compatibility should be monitored in patients requiring adjunctive therapy.

Gastrointestinal: vomiting, anorexia, diarrhea, melena, gastrointestinal ulceration
Urinary: azotemia, elevated creatinine, renal failure
Neurological/Behavioral: lethargy, depression
Hepatic: elevated liver enzymes
Dermatologic: pruritus

Death has been reported as an outcome of the adverse events listed above. Acute renal failure and death have been associated with use of meloxicam in cats.

Information For Dog Owners: Metacam, like other drugs of its class, is not free from adverse reactions. Owners should be advised of the potential for adverse reactions and be informed of the clinical signs associated with drug intolerance. Adverse reactions may include vomiting, diarrhea, decreased appetite, dark or tarry stools, increased water consumption, increased urination, pale gums due to anemia, yellowing of gums, skin or white of the eye due to jaundice, lethargy, incoordination, seizure, or behavioral changes. Serious adverse reactions associated with this drug class can occur without warning and in rare situations result in death (see Adverse Reactions). Owners should be advised to discontinue Metacam and contact their veterinarian immediately if signs of intolerance are observed. The vast majority of patients with drug related adverse reactions have recovered when the signs are recognized, the drug is withdrawn, and veterinary care, if appropriate, is initiated. Owners should be advised of the importance of periodic follow up for all dogs during administration of any NSAID.

Effectiveness: The effectiveness of meloxicam was demonstrated in two field studies involving a total of 224 dogs representing various breeds, between six months and sixteen years of age, all diagnosed with osteoarthritis. Both of the placebo-controlled, masked studies were conducted for 14 days. All dogs received 0.2 mg/kg meloxicam on day 1. All dogs were maintained on 0.1 mg/kg oral meloxicam from days 2 through 14 of both studies. Parameters evaluated by veterinarians included lameness, weight bearing, pain on palpation, and overall improvement. Parameters assessed by owners included mobility, ability to rise, and overall improvement in the veterinary clinic. In the first field study (n=148), dogs receiving meloxicam showed a clinical improvement after 14 days of therapy for all parameters evaluated. Statistically significant improvement was demonstrated only for the overall investigator evaluation on day 7, and for the owner evaluation on day 14.

Reference: 1. FIO for NADA 141-213 Metacam (meloxicam oral suspension).

Manufactured for:
Boehringer Ingelheim Vetmedica, Inc.
St. Joseph, MO 64506 U.S.A.

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5 mg/mL Solution for Injection

Description: Meloxican is a non-steroidal anti-inflammatory drug (NSAID) of the oxicam class. Each mL of this sterile product for injection contains meloxicam 5.0 mg, alcohol 15%, glycerol 10%, poloxamer 1.85%, sodium chloride 0.8%, glycine 0.5% and meglumine 0.3%, in water for injection, pH adjusted with sodium hydroxide and hydrochloric acid.

Indications: Dogs: Metacam (meloxicam) 5 mg/mL Solution for Injection is indicated in dogs for the control of pain and inflammation associated with osteoarthritis.

Contraindications: Dogs with known hypersensitivity to meloxicam should not receive Metacam 5 mg/mL Solution for Injection.

Warnings: Not for use in humans. Keep this and all medications out of reach of children. Consult a physician in case of accidental ingestion by humans. For IV or SQ injectable use in dogs. All dogs should undergo a thorough history and physical examination before administering any NSAID. Appropriate laboratory testing to establish hematological and serum biochemical baseline data is recommended prior to, and periodically during use of any NSAID in dogs.

Owner should be advised to observe their dogs for signs of potential drug toxicity.

Precautions: The safe use of Metacam 5 mg/mL Solution for Injection in dogs younger than 6 months of age, dogs used for breeding, or in pregnant or lactating bitches has not been evaluated. Meloxicam is not recommended for use in dogs with bleeding disorders, as safety has not been established in dogs with these conditions. Safety has not been established for intramuscular (IM) administration in dogs. When administering Metacam 5 mg/mL Solution for Injection, use a syringe of appropriate size to ensure precise dosing. Metacam is contraindicated in dogs with blood dyscrasias, as safety has not been established in dogs with blood dyscrasias. Sensitivity to drug-associated adverse events varies with the individual patient. Dogs that have experienced adverse reactions from one NSAID may experience adverse reactions from another NSAID. Patients at greatest risk for renal toxicity are those that are dehydrated, on concomitant diuretic therapy, or those with existing renal, cardiovascular, and/or hepatic dysfunction. Concurrent administration of potentially nephrotoxic drugs should be carefully avoided. NSAIDs may inhibit the prostaglandin pathway and maintenance of normal homeostatic function. Such anti-prostaglandin effects may result in clinically significant disease in patients with underlying or pre-existing disease that has not been previously diagnosed. Since NSAIDs possess the potential to induce gastrointestinal ulcerations and/or perforations, concomitant use with other anti-inflammatory drugs, such as NSAIDs or corticosteroids, should be avoided. If additional pain medication is needed after administration of the total daily dose of Metacam Oral Suspension, a non-NSAID or non-corticosteroid class of analgesia should be considered. The use of another NSAID is not recommended. Consider appropriate washout times when switching from corticosteroid use or from one NSAID to another in dogs. The use of concurrent protein-bound drugs may affect the pharmacokinetics of Metacam Oral Suspension. Commonly used protein-bound drugs include cardiac, anticonvulsant and behavioral medications. The influence of concomitant drugs that may inhibit metabolism of Metacam 5 mg/mL Solution for Injection has not been evaluated. Drug compatibility should be monitored in patients requiring adjunctive therapy.

Adverse Reactions: Dogs: A field study involving 224 dogs was conducted. Based on the results of this study, GI abnormalities (vomiting, soft stools, diarrhea, and inappetence) were the most common adverse reactions associated with the administration of meloxicam.

The following adverse reactions are based on post-approval adverse drug event reporting. The categories are listed in decreasing order of frequency by body system:

Gastrointestinal: vomiting, diarrhea, melena, gastrointestinal ulceration
Urinary: azotemia, elevated creatinine, renal failure
Neurological/Behavioral: lethargy, depression
Hepatic: elevated liver enzymes
Dermatologic: pruritus

Death has been reported as an outcome of the adverse events listed above. Acute renal failure and death have been associated with the use of meloxicam in cats.

Information For Dog Owners: Meloxicam, like other NSAIDs, is not free from adverse reactions. Owners should be advised of the potential for adverse reactions and be informed of the clinical signs associated with NSAID intolerance. Adverse reactions may include vomiting, diarrhea, lethargy, decreased appetite and behavioral changes. Dogs owners should be advised when their pet has received a meloxicam injection. Dog owners should contact their veterinarian immediately if possible adverse reactions are observed, and dog owners should be advised to discontinue Metacam therapy.

Effectiveness: Dogs: The effectiveness of Metacam 5 mg/mL Solution for Injection was demonstrated in a field study involving 224 dogs representing various breeds, all diagnosed with osteoarthritis. This placebo-controlled, masked study was conducted for 14 days. Dogs received a subcutaneous injection of 0.2 mg/kg Metacam 5 mg/mL Solution for Injection on day 1. The dogs were maintained on 0.1 mg/kg oral meloxicam from days 2 through 14. Variables evaluated by veterinarians included lameness, weight bearing, pain on palpation, and overall improvement. Variables assessed by owners included mobility, ability to rise, and overall improvement in the veterinary clinic. In the first field study (n=148), dogs receiving meloxicam showed a clinical improvement after 14 days of therapy for all parameters evaluated. Statistically significant improvement was demonstrated only for the overall investigator evaluation on day 7, and for the owner evaluation on day 14.

Reference: 1. FIO for NADA 141-219 Metacam (meloxicam) 5 mg/mL Solution for Injection.

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Boehringer Ingelheim Vetmedica, Inc.
St. Joseph, MO 64506 U.S.A.

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601507-01
Revised 08/2016
Inappetence/ Decreased Appetite 1
Bruising at Surgery Site 2
Respiratory Arrest 1
Diarrhea 1
Somnolence 1
Pain 2
Lethargy 1
Decreased Appetite or Anorexia 3
Vomiting 5

**Adverse Reactions:**

PREVICOX Chewable Tablets at a dose of 2.27 mg/lb (5.0 mg/kg) orally once daily for 30 days. The following adverse reactions were observed. Dogs may have experienced more than one of the observed reactions during the study.

**Adverse Reactions Seen in U.S. Field Studies**

<table>
<thead>
<tr>
<th>Adverse Reactions</th>
<th>PREVICOX (n=128)</th>
<th>Active Control (n=121)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vomiting</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Donepezol-Apple of Ameba</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Leukopenia</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Pain</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Somnolence</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

**Adverse Reactions Seen in the Soft-tissue Surgery**

<table>
<thead>
<tr>
<th>Adverse Reactions</th>
<th>Firocox Group (n=127)</th>
<th>Control Group (n=131)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vomiting</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Brushing at Surgery Site</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Respiratory Arrest</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SG Cytosis in n/Leg and Flank</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Seizure Prof.</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Soft-tissue Surgery:** In controlled field studies evaluating soft tissue postoperative pain and inflammation, 258 dogs (10.5 weeks to 16 years) were evaluated for safety when given PREVICOX Chewable Tablets at a dose of 2.27 mg/lb (5.0 mg/kg) orally approximately 2 hours prior to surgery and once daily thereafter for a total of two days. The following adverse reactions were observed. Dogs may have experienced more than one of the observed reactions during the study.

**Adverse Reactions Seen in the Orthopedic Surgery**

<table>
<thead>
<tr>
<th>Adverse Reactions</th>
<th>Firocox Group (n=118)</th>
<th>Control Group (n=108)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vomiting</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Stabbing at Surgery Site</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Inappropriate Decreased Appetite</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Paralytic</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Insomnia</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Incoordination, Headache</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

**Ortopedic Surgery:** In a controlled field study evaluating orthopedic postoperative pain and inflammation, 238 dogs of various breeds, ranging in age from 1 to 11.9 years in the PREVICOX-treated groups and 0.7 to 17 years in the control group was conducted. Dogs were randomly assigned to either the PREVICOX or the control group. The study (n = 220 for each arm) was carried out to evaluate the effect of PREVICOX compared with the active control. At the study’s end, 87% of the owners rated PREVICOX-treated dogs as improved. Eighty-eight percent of dogs treated with PREVICOX were also judged improved by the veterinarians. Dogs treated with PREVICOX had a higher level of improvement in pain and lameness assessment scores at the end of the study period compared to the control group, and owner-assessed improvement that was comparable to the active control. The level of improvement in PREVICOX-treated dogs was significantly lower for rescue medication than the control (sham-dosed-pill) group for the control of postoperative pain and inflammation associated with orthopedic surgery. Surgery to repair a ruptured cruciate ligament included the following stabilization procedures: fabellar suburet and/or, intramedullary fixation, fibular head transposition, tibial plateau leveling osteotomy (TPLO), and ‘over the top’ technique. The study showed that PREVICOX-treated dogs had significantly lower need for rescue medication than the control (sham-dosed-pill) in controlling postoperative pain and inflammation associated with orthopedic surgery.

**Animal Safety:** In a targeted animal safety study, firocoxib was administered orally to healthy adult Beagle dogs (eight dogs per group: 5, 11, and 25 mg/kg) for 7 days. The recommended total daily dose for dogs of up to 125 lbs (56 kg) is 2.27 mg/lb (5.0 mg/kg orally) if the dog is 11.5 kg or less. For dogs over 11.5 kg, the recommended total daily dose is 3.41 mg/lb (7.5 mg/kg orally). For dogs over 220 lbs (100 kg), the maximum dose is 7.04 mg/lb (15 mg/kg orally). The maximum dose for dogs less than 11.5 kg is 11.0 mg/kg orally. When compared to placebo, firocoxib was well tolerated in a two-week dose escalation study involving a total of six dogs. Firocoxib was administered once daily for 2 weeks at doses of 1, 3, and 5 times the recommended dose. The dogs were evaluated for signs of potential drug toxicity (see Adverse Reactions and Animal Safety) and to obtain a Client Information Sheet about PREVICOX Chewable Tablets. For technical assistance or to report suspected adverse events, call 1-877-217-3543. For additional information about adverse drug reporting for animals, contact FDA at 1-888-FDA-VETS at http://www.fda.gov/ AnimalVets/Animal/Health/.
An exploratory celiotomy is a common nonelective surgery in veterinary medicine. An exploratory celiotomy should be systematic to ensure every structure is examined without the clinician becoming distracted by obvious lesions and missing other subtle abnormalities.

A sufficient incision from the xiphoid to the pubis must be created for the entire abdomen to be accessible. Therefore, the abdomen must be appropriately clipped, prepped, and draped. The clipping should extend from ≈4 cm cranial to the xiphoid to ≈4 cm caudal to the cranial brim of the pubis. The abdomen should be clipped ≈3 to 4 cm lateral to the nipples. The entire clipped area should be prepped with initial skin cleaning and the prepuce flushed with dilute 0.05% chlorhexidine diacetate solution¹ in a sufficient volume to result in mild distention of the prepuce. The fluid should be agitated in the prepuce, then drained and repeated for a total of 2 minutes. The patient should then be placed in the operating room, and a sterile surgical scrub should be performed, after which the patient can be draped. The drapes should be applied ≈2 cm from the hairline, 2 cm cranial to the xiphoid, and 2 cm caudal to the pubis. For male dogs in which the urethra does not need to be accessed during surgery, the prepuce should be towel clamped out of the field prior to quarter draping. Once the prepuce is lateralized, the quarter drape should be placed over the preputial orifice. If the urinary tract needs to be accessed during surgery (eg, to facilitate urocystolith removal), the prepuce should remain in the surgical field.
The linea alba should be identified and incised. In female dogs, the skin, subcutaneous, and fascial incisions should be made on the ventral midline. In male dogs, the skin incision should be curved around the prepuce, and the subcutaneous tissue should be dissected to identify the linea alba.

Following incision through the linea alba, the falciform fat can be visualized attached along the ventral midline. This fat should be inspected for abnormalities (eg, acquired portosystemic shunts, metastatic disease), then removed from each side of the midline using electrosurgery or scissors and ligated cranially at the level of the xiphoid. Ligation of the falciform fat helps prevent hemorrhage from the normal vessels coursing through the fat.

Once the falciform fat is removed, the edges of the incision should be covered with moistened laparotomy pads. Use of an abdominal retractor (eg, Balfour retractor) is important to allow the surgeon to easily inspect the entire abdomen. Once the retractor is in place, the abdomen should be quickly examined for active hemorrhage or lesions that require immediate attention. If none are detected, the systematic abdominal exploration can commence.

Often, the surgeon will divide the abdomen into imaginary sections: cranial, right dorsal, left dorsal, midventral (which includes the GI tract), and caudal. The cranial abdomen is often inspected first. The liver should be gently retracted caudally with a flat hand to examine the diaphragm. Then, each liver lobe should be inspected. The liver lobes from left to right are: left lateral, left medial, quadrate, right medial, right lateral, and the caudate process of the caudate lobe. The papillary process of the caudate lobe is located cranial to the lesser curvature of the stomach, dorsal to the lesser omentum. The caudate process of the caudate lobe and the right lateral liver lobes can be more easily seen during inspection of the right dorsal abdomen.

Examining the biliary tree during liver inspection is ideal. The gallbladder is located between the right medial and quadrate lobes of the liver. When indicated, it can be gently squeezed with continuous gentle pressure to assess patency of the biliary tree. The cystic and common bile ducts can be inspected by gently retracting the gallbladder with attached quadrate and right medial liver lobes cranioventrally and retracting the duodenum caudally. The common bile duct courses through the hepatoduodenal ligament to empty in the duodenum ≈2 to 3 cm aboral to the pylorus.

Next, the right dorsal abdomen, often referred to as the right gutter, should be inspected. The right gutter can be accessed by gently grasping the descending duodenum and using the mesoduodenum as a retractor. The duodenum should be lifted and retracted medially to expose the right dorsal abdominal structures. While the right dorsal abdomen is

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The caudate process of the caudate lobe and the right lateral liver lobes can be more easily seen during inspection of the right dorsal abdomen.
exposed, the caudate process of the caudate lobe, the right lateral lobe of the liver, and the right limb of the pancreas can be more easily visualized. The caudate process of the caudate lobe is located dorsally, cupping the right kidney and often overlying the right adrenal gland. The right adrenal gland may not be visualized, but it can be palpated for masses. The portal vein and caudal vena cava can be seen best while the right gutter is exposed.

To examine the left dorsal section/left gutter, the descending colon can be grasped on the left side of the abdomen, lifted, and pulled toward the right body wall, using the mesocolon as a natural retractor and exposing the left dorsal abdominal structures. The left adrenal gland can easily be seen cranial to the left kidney.

The spleen is a mobile structure. It can be grasped gently and lifted to facilitate full inspection. All surfaces of the spleen should be evaluated, along with the vasculature supplying it. Siderotic plaques (Figure) are a common, normal finding. The size of the spleen can be variable based on the condition of the patient and the drugs that have been administered.

The caudal duodenal flexure is rendered relatively immobile by the duodenocolic ligament. To facilitate examination, the jejunum can be swept cranially and to the right and the colon swept to the left. Complete examination is important, as GI foreign bodies may have difficulty making this tight turn and become lodged in this location. Each surface of the jejunum, ileum, cecum, and colon should be inspected and gently palpated for abnormalities. The mesentery, mesenteric lymph nodes, and cecal lymph nodes should also be inspected.

Next, the caudal abdomen should be visualized and inspected. To identify the ureters entering the urinary bladder, the bladder must be reflected ventrally. At the same time, the uterus or uterine stump can be inspected in its location dorsal to the urinary bladder. Cranial traction may be placed on the urinary bladder to palpate the prostate. Although the prostate may be far enough in the pelvic canal that it may not be visualized, it should still be palpated. The sacral lymph nodes are located in the pelvic canal and can typically only be palpated when enlarged.

As the exploratory celiotomy progresses, abnormalities should be noted and biopsied or aspirated when appropriate. If no abnormalities are detected, biopsies should be taken from the organs that are most likely involved in the patient’s disease (eg, stomach, duodenum, jejunum, and ileum in animals with vomiting and diarrhea; liver in a dog with elevated liver enzymes). When GI biopsies are performed, multiple locations should be biopsied, including 2 to 3 locations from the jejunum. The colon is not routinely biopsied unless colonic disease is likely.
**WHAT YOU WILL NEED**
- Balfour retractor
- Sterile saline
- Laparotomy pads
- Standard surgical pack
- ± Babcock forceps

**STEP-BY-STEP EXPLORATORY CELIOTOMY**

**STEP 1**
Clip the patient’s abdomen, extending from ≈4 cm cranial to the xiphoid to ≈4 cm caudal to the cranial brim of the pubis (A) and ≈3 to 4 cm lateral to the nipples (B). Clean the clipped area, and, in male dogs, flush the prepuce with dilute chlorhexidine solution.

Move the patient to the operating room, and perform a sterile surgical scrub. If the patient is male and the urethra does not need to be accessed, towel clamp the prepuce out of the field (C). Drape the patient. If the patient is male, place the quarter drape over the preputial orifice (D).

**STEP 2**
Make an incision from the xiphoid to the pubis; if the patient is male, curve the skin incision around the prepuce. Identify and incise the linea alba.
**STEP 3**

Inspect the falciform fat for abnormalities, then use electrosurgery or scissors to reflect the falciform fat and ligate it cranially at the level of the xiphoid.

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**STEP 4**

Cover the edges of the incision with moistened laparotomy pads, then insert an abdominal retractor.

Observe the abdomen for active hemorrhage and other lesions. With a flat hand, gently retract the liver caudally and examine the diaphragm. Inspect each liver lobe. In appropriate cases, gently squeeze the gallbladder, applying continuous pressure to express it. Retract the gallbladder (with attached quadrate and right medial liver lobes) cranioventrally, and retract the duodenum caudally to inspect the cystic and common bile ducts.

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**STEP 5**

Inspect the right dorsal abdomen (A and B). Lift the duodenum, and retract it medially to expose the right dorsal abdominal structures (A). Insert a finger dorsal to the caudate process of the caudate lobe and cranial to the right kidney, and palpate the right adrenal gland for the presence of masses.

Repeat with the left dorsal abdomen (C).
**STEP 6**

Gently grasp and lift the spleen to evaluate the surface and vasculature.

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**STEP 7**

Palpate the esophageal hiatus by passing a hand between the stomach and the left body wall, moving dorsally and following the curve of the stomach until it meets the diaphragm. Make a hole in the ventral leaf of the greater omentum, and lift the stomach ventrally. Place a finger or atraumatic forceps (eg, Babcock) on the dorsal stomach and lift it ventrally. Only leave the forceps in place briefly to avoid damaging delicate tissues. Visualize and palpate the dorsal stomach, and inspect the left limb of the pancreas through the rent in the omentum (see Video). Retract the stomach cranioventrally to visualize the GI tract.

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**VIDEO**

To view a video showing inspection of the left limb of the pancreas and the dorsal stomach, scan the QR code below. An avascular portion of the greater omentum is found and a rent is made.

Using QR codes from your mobile device is easy and quick!

Simply focus your phone’s camera on the QR code as if taking a picture (but don’t click!). A notification banner will pop up at the top of your screen; tap the banner to view the linked content.

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**STEP 8**

Palpate the pylorus (arrow) and the descending duodenum (arrowhead), and inspect the right limb and body of the pancreas.

**Author Insight**

A normal pylorus should feel thicker than the remainder of the stomach.
STEP 9
Sweep the jejunum craniomedially, and examine the intestines from an oral or aboral approach. Using a gentle hand-over-hand motion (A) and without aggressively pinching the intestines while they move through the fingers, inspect each surface of the jejunum, ileum, cecum, and colon, and gently palpate for abnormalities. Inspect the mesentery, jejunal lymph nodes, and colic lymph nodes.

Author Insight
If a foreign body is located in the caudal duodenal flexure, the duodenocolic ligament can be transected to increase mobility and facilitate foreign body removal. The duodenocolic ligament (B, circled) is continuous with the peritoneum, which covers the mesenteric root (ie, jejunal arteries); therefore, transection of this structure can be safely performed in the translucent avascular area.

STEP 10
Inspect the urinary bladder and prostate or uterus/uterine stump. Identify the ureters entering the urinary bladder by reflecting the bladder ventrally and caudally (arrow). At the same time, inspect the uterus or uterine stump in its location dorsal to the urinary bladder (circle shows an enlarged uterine stump), or palpate the prostate.

References
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 all 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 and more.

NVA has over 700 partnerships in the US, Canada, Australia and New Zealand. Our passionate, visionary local pet resort and hospital leaders embody NVA’s unique entrepreneurial spirit. We’d be more than happy to talk through your questions and concerns. You can reach us at: 888.767.7755 | NVA.com | info@NVA.com

Dr. John Paulson, Ridgetop Animal Hospital
NVA partner since 2012.
CASE IN POINT

VOMITING & DIARRHEA IN A LETHARGIC DOG

April Summers, DVM, PhD
Cornell University

Julien Guillaumin, DVM, DACVECC, DECVECC
Colorado State University
Max, an 8-year-old, 32-lb (14.5-kg), neutered male border collie, was emergently presented for vomiting, diarrhea, and lethargy of 3 days’ duration. He was fed a veterinary commercial diet but, when he began vomiting, was transitioned to a bland diet of boneless, skinless boiled chicken and white rice; however, he continued to vomit while on the bland diet.
Max had a previous history of 2 exploratory laparotomies for foreign bodies but had no other major medical history. He was the only dog in the household, had access to a fenced backyard, and had no significant travel history. He was up to date on vaccines and flea, tick, and heartworm prevention.

**Physical Examination**

On presentation, Max was laterally recumbent, obtunded, and ≈7% dehydrated. He was pyrexic (temperature, 104.5°F [40.3°C]) and tachycardic (150 bpm) with a normal respiratory rate (28 breaths per minute). Mucous membranes were pale, and capillary refill time was prolonged (ie, 3 seconds). He had weak peripheral pulses, and his distal limbs and paw pads were cool to the touch. Harsh lung sounds were auscultated bilaterally throughout all lung fields. He was painful on abdominal palpation, particularly in the cranial abdomen, and had profuse hemorrhagic diarrhea; he also passed pieces of 2 rubber ball toys from his rectum. His owners did not report any foreign material having been passed at home. The remainder of the physical examination was unremarkable.

**Diagnosis & Clinical Management**

Venous blood gas analysis revealed metabolic acidosis due to hyperlactatemia and hypoglycemia (Table 1). ECG revealed sinus tachycardia. Systolic blood pressure was 40 mm Hg (Doppler); an arterial catheter was subsequently placed, and direct arterial blood pressure monitoring was initiated.

Images obtained using abdominal-focused assessment with sonography for trauma revealed no evidence of free fluid. Images obtained using thoracic-focused assessment with sonography for trauma revealed 4 to 5 B lines in the region of the right middle lung lobe; B lines are reverberation artifacts and can be present with interstitial edema as air content decreases. Abdominal radiographs

### Table 1

**VENOUS BLOOD GAS RESULTS**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Presenting Value</th>
<th>Reference Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.22</td>
<td>7.35-7.47</td>
</tr>
<tr>
<td>Partial pressure of carbon dioxide (mm Hg)</td>
<td>46</td>
<td>32-43</td>
</tr>
<tr>
<td>Bicarbonate (mEq/L)</td>
<td>13.7</td>
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<td>Sodium (mEq/L)</td>
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<tr>
<td>Calcium (mg/dL)</td>
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</tr>
<tr>
<td>Base deficit (mEq/L)</td>
<td>7.2</td>
<td>-4 to 4</td>
</tr>
</tbody>
</table>

### Table 2

**CBC RESULTS**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Presenting Value</th>
<th>Reference Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hematocrit (%)</td>
<td>44</td>
<td>37.3-61.7</td>
</tr>
<tr>
<td>Total leukocytes (cells/µL)</td>
<td>20,700</td>
<td>5050-16,760</td>
</tr>
<tr>
<td>Neutrophils (cells/µL)</td>
<td>17,000</td>
<td>2950-11,640</td>
</tr>
<tr>
<td>Bands (cells/µL)</td>
<td>3000</td>
<td>0-100</td>
</tr>
<tr>
<td>Lymphocytes (cells/µL)</td>
<td>1000</td>
<td>1050-5100</td>
</tr>
<tr>
<td>Monocytes (cells/µL)</td>
<td>1900</td>
<td>160-1120</td>
</tr>
<tr>
<td>Eosinophils (cells/µL)</td>
<td>60</td>
<td>60-1230</td>
</tr>
<tr>
<td>Basophils (cells/µL)</td>
<td>0</td>
<td>100</td>
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<tr>
<td>Platelet count (x10³/µL)</td>
<td>62</td>
<td>148-484</td>
</tr>
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revealed fluid-filled loops of intestine consistent with diffuse ileus; however, there was no evidence of GI obstruction. Abdominal sonograms were suggestive of pancreatitis with focal peritonitis but were otherwise unremarkable. Thoracic radiographs revealed an alveolar pattern in the right middle lung lobe that was suggestive of aspiration pneumonia.

Initial laboratory values revealed leukocytosis characterized by monocytosis and neutrophilia with a left shift (Table 2). Max was also thrombocytopenic. Serum chemistry profile revealed decreased albumin and globulin and increased ALT, ALP, and total bilirubin (Table 3).

Max was stabilized with crystalloid fluid boluses (lactated Ringer’s solution [total, 40 mL/kg IV]), followed by a colloid bolus (6% hydroxyethyl starch in sodium chloride [5 mL/kg IV]) administered over 20 minutes. Of note, the use of synthetic colloids is controversial in humans with sepsis due to increased risk for acute kidney injury. Two 25% dextrose boluses (1 mL/kg IV) were also administered to help treat hypoglycemia. Broad-spectrum antibiotic therapy (ie, ampicillin/sublactam [30 mg/kg IV], enrofloxacin [10 mg/kg IV]) was initiated within an hour of admission, and oxygen supplementation (100 mL/kg/min increased to a maximum of 4-5 L/min) was provided via nasal cannula.

Because Max’s blood pressure did not respond adequately to fluid therapy and had an oscillometric mean of 50 mm Hg, septic shock was diagnosed. Norepinephrine at 0.2 μg/kg/min CRI was initiated and increased incrementally by 0.1 μg/kg/min to 0.8 μg/kg/min within 45 minutes, at which point vasopressin (0.5 milliUnits/kg/min CRI IV) was initiated.

**DIAGNOSIS:**

**SEPTIC SHOCK WITH SUSPECTED CRITICAL ILLNESS-RELATED CORTICOSTEROID INSUFFICIENCY (CIRCI)**

Due to the lack of improvement in blood pressure with increasing doses of vasopressors, CIRCI was

<table>
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<tr>
<th>Variable</th>
<th>Presenting Value</th>
<th>Reference Range</th>
</tr>
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<tbody>
<tr>
<td>Albumin (g/dL)</td>
<td>2.6</td>
<td>2.9-4.2</td>
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<tr>
<td>Globulin (g/dL)</td>
<td>1.2</td>
<td>2.2-2.9</td>
</tr>
<tr>
<td>ALT (U/L)</td>
<td>88</td>
<td>10-55</td>
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<tr>
<td>ALP (U/L)</td>
<td>361</td>
<td>15-120</td>
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<tr>
<td>γ-glutamyl transferase (U/L)</td>
<td>6</td>
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<td>Total bilirubin (mg/dL)</td>
<td>0.9</td>
<td>0.1-0.4</td>
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**TREATMENT AT A GLANCE**

- Vital parameters and blood work abnormalities should be closely monitored.
- Hypoglycemia and electrolyte abnormalities should be treated as necessary.
- Blood pressure monitoring and response to vasopressor therapy is an important component of identifying potential CIRCI patients.
- Due to the lack of dosage information available for injectable hydrocortisone,7 hydrocortisone at 1 mg/kg IV bolus followed by CRI at 0.08 mg/kg/hr can be considered as a modification of the human protocol.5,8
- If injectable hydrocortisone is unavailable, other corticosteroids, including prednisone (0.7-1.4 mg/kg/day), can be considered.

CIRCI = critical illness-related corticosteroid insufficiency
CASE IN POINT  ▶  EMERGENCY MEDICINE & CRITICAL CARE  ▶  PEER REVIEWED

strongly suspected. Resting cortisol was 6.96 μg/dL (reference range, 1.8-9 μg/dL), and hydrocortisone sodium succinate (1 mg/kg IV bolus followed by CRI at 0.08 mg/kg/hr) was subsequently initiated to treat possible comorbid CIRCI (see Treatment at a Glance, previous page).

Prognosis & Outcome
Despite treatment and supportive care, Max’s status continued to decline and he suffered cardiopulmonary arrest 6 hours after presentation. Autopsy confirmed aspiration pneumonia, gastroenteritis, and pancreatitis.

Septic shock is uncommonly reported in veterinary medicine, and prognosis is poor even with treatment. Reported survival rate in dogs with hypotension severe enough to require vasopressor therapy has been reported to be ≈10% to 20% as compared with a 40% survival rate in humans.1-3 The prognosis for septic shock for humans and dogs with CIRCI is unknown.

The diagnosis of CIRCI in veterinary medicine can be challenging, as CIRCI has no specific diagnostic criteria; however, it should be suspected in any patient with vasopressor-refractory hypotension. In humans, it is recommended to initiate hydrocortisone therapy without additional tests when there is vasopressor-refractory hypotension.4

There has been no agreement on a single test for definitive diagnosis of CIRCI in humans, although a blunted ACTH stimulation test with a Δ-cortisol result <9 μg/dL and/or a resting cortisol level <10 μg/dL have been suggested to be indicative of CIRCI.4,7,8 In veterinary medicine, a study in septic dogs found that a Δ-cortisol level <3 μg/dL obtained from a standard 1-hour ACTH stimulation test using 250 μg of cosyntropin was associated with hypotension and decreased survival.9

Prompt recognition of potential CIRCI is important, as earlier shock resolution can lead to lower mortality in patients with septic shock.10 Early injectable hydrocortisone administration may be considered as a treatment regimen in septic shock patients with vasopressor-refractory hypotension.5,10

Discussion
CIRCI is defined as inadequate corticosteroid activity in relation to the severity of a patient’s illness (see Take-Home Messages).4 CIRCI has been reported to occur in ≈60% of humans with severe sepsis and septic shock.5 The cause of hypothalamic–pituitary–adrenal axis dysfunction is poorly understood. Potential factors of this dysfunction include decreased production of adrenocorticotropic hormone (ACTH), corticotropin-releasing hormone, and cortisol; dysfunction of their associated receptors; adrenal damage from infarction or hemorrhage; adrenal suppression from chronic exogenous glucocorticoid administration; and inflammatory cytokines causing systemic inflammation-associated glucocorticoid resistance. No specific guidelines exist in veterinary medicine for diagnosing or treating CIRCI, and only rare case reports exist. The recommendation for treatment of CIRCI in humans is administration of injectable hydrocortisone, preferably as a constant rate infusion.6

TAKE-HOME MESSAGES
▶ Septic shock is defined as an infection associated with systemic hypotension that occurs despite adequate fluid resuscitation and requires use of vasopressors to maintain a mean arterial blood pressure ≥65 mm Hg.
▶ Treatment of septic shock is complex and often requires continuous assessment and adjustment based on the dynamic needs of the patient. Early source control and administration of appropriate antibiotics is a critical treatment goal for patients with sepsis.
▶ CIRCI is a form of adrenal insufficiency in critically ill patients and should be suspected in patients with vasopressor-refractory hypotension. In humans, it is recommended to initiate hydrocortisone therapy without additional tests when there is vasopressor-refractory hypotension.
▶ Diagnosis of CIRCI in veterinary medicine can be challenging, as CIRCI has no specific diagnostic criteria; however, it should be suspected in any patient with vasopressor-refractory hypotension.
▶ There has been no agreement on a single test for definitive diagnosis of CIRCI in humans, although a blunted ACTH stimulation test with a Δ-cortisol result <9 μg/dL and/or a resting cortisol level <10 μg/dL have been suggested to be indicative of CIRCI.4,7,8 In veterinary medicine, a study in septic dogs found that a Δ-cortisol level <3 μg/dL obtained from a standard 1-hour ACTH stimulation test using 250 μg of cosyntropin was associated with hypotension and decreased survival.
▶ Prompt recognition of potential CIRCI is important, as earlier shock resolution can lead to lower mortality in patients with septic shock.
▶ Early injectable hydrocortisone administration may be considered as a treatment regimen in septic shock patients with vasopressor-refractory hypotension.5,10
References


ACTH = adrenocorticotropin hormone  
CIRCI = critical illness-related corticosteroid insufficiency

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October 2019 cliniciansbrief.com 71
In my practice a flexible fiber CO₂ surgical laser is used daily. Whether for dermal neoplasia, any soft tissue surgery, laparotomies or orthopedics, I request its use. I cannot think of a more valuable piece of equipment when surgeries are performed on exotics that are frequently brought into our practice than the CO₂ surgical laser. (See figures 1a-5.)

In my experience, it allows for an easier, more comfortable recovery from surgery and a quicker return to function (e.g., patient in figure 5 shows no discomfort in its post-operative recovery). Concern about blood loss, pain and swelling is all but eliminated as the laser cuts, ablates or coagulates soft tissue. This is especially important for tiny patients like rodents, rabbits, birds, reptiles, amphibians, primates and fish. For example, Jacque-Marie Leclerc, DVM, of France, described a CO₂ laser surgical treatment of fibrosarcoma in a goldfish. He pointed out that his flexible fiber Aesculight laser had been crucial and that he could not have obtained such a good result without the technology, a key element for convenience, speed and success.

Clinical Benefits

➤ The ability to control hemorrhage is critical. A loss of just several drops of blood may exsanguinate a patient or at least initiate a trend towards hypovolemia. The laser helps to control bleeding. With it, blood vessels under 0.6 mm in diameter can be effectively coagulated and sealed, which enables a bloodless field of view. Laser surgery, therefore, saves time the surgeon and the team would otherwise have to spend maintaining the surgical site free of blood. This leads to a shorter surgery and anesthesia time. In addition, the laser’s ability to control bleeding ensures a better esthetic result. Figures 3, 6 and 7b show bloodless laser surgeries in progress.

➤ Another critical advantage of the laser over a conventional scalpel is the laser’s ability to prevent infection. All cutting is done with the focused laser beam without the tip directly touching the wound, which reduces the risk of infection. In addition, laser energy has sanitizing effect; i.e. it kills bacteria where it cuts.

Figure 4 shows the successful result of CO₂ laser surgery in a green iguana. In this case, as often happens with green iguanas, amputations were needed to eliminate bacterial infections and the CO₂ laser was the perfect surgical tool for this purpose.

➤ Pain management is of paramount importance postoperatively, especially with exotics. Birds, rodents, rabbits and primates will pick and barber their wounds and incisions, if hurting. Even when sutures are buried, pain frequently ends in dehiscence or even worse, evisceration. If the skin doesn’t look or feel normal, self-destruction and mutilation may ensue. The laser incision drastically reduces postoperative pain because of its effect on sensory innervation. Figure 5 depicts a ferret fox recovering after a femoral head osteotomy.

The patient appears comfortable and not in pain.

➤ Postoperative swelling is another concern that may be eliminated with laser surgery. Unless I am ablating tissue, when I work with the laser in the continuous wave mode, I utilize the SuperPulse mode for soft tissue incisions. With it, there is less heat and tissue charring and therefore, less collateral damage. Swelling and distention may cause patient pain, stress, inactivity, inappetence and a slower recovery, and the use of the laser ensures little to no postoperative swelling.

➤ Laser utilization may shorten the stay away from home. A shorter hospital stay allows the patient to return to its home environment or habitat sooner. This decreases the patient’s stress, and facilitates a return to normal feeding and therefore eliminations.

Benefits for the Practice

Financially, the laser is an asset. The repertoire of surgeries we offer has increased. The CO₂ laser has also made our practice more efficient, i.e., the ability to control bleeding and maintain good visualization intraoperatively reduces operative time; shortened surgical time enables the clinician to perform more surgeries per day or week. An additional fee is added to the procedure when the laser is utilized, creating an additional revenue stream for the practice. And clients typically do not mind the additional fee for a much better quality of care for their pets. Since our practice has started offering CO₂ laser surgery, referrals have increased, as the ability to provide laser surgery separates our practice from others. It also emphasizes our high standards of patient care.

Conclusion

Our flexible fiber CO₂ laser has helped us to expand the surgical capabilities of our practice. We have increased our client pool by offering a broader spectrum of services, achieving great surgical results and promoting compassionate post-operative care with diminished swelling, pain and reduced bleeding, need for sutures and/or bandages. We have found the use of our laser very rewarding.
Figure 1a. Tail tip neoplasia in a ferret, pre-op view

Figure 1b. Nail tip neoplasia shown in 1a, was excised with a CO₂ laser, immediately post-op view

Figure 2. Pre-op view. Abscessation in rabbits is not uncommon. Bloodless laser excision in situ can be easily accomplished with the CO₂ laser.

Figure 3. Sugar glider castration and tail tip amputation were performed utilizing the CO₂ laser. Note the bloodless operative field. No sutures were required.

Figure 4. Green iguanas frequently require toe amputations to eliminate bacterial infections. No sutures are required when the laser is utilized.

Figure 5. Orthopedics may be facilitated with the CO₂ laser. Depicted is a fennec fox recovering from a femoral head ostectomy. Note his painless posture.

Figure 6. This lemur neonate has a propitious left globe. Emergency enucleation was required. Laser utilization enabled a rapid, bloodless enucleation.

Figures 7a and 7b. This chinchilla required surgery to remove plastic obstructing the small bowel. Surgery was quick and virtually painless because the CO₂ laser was used.

WATCH CO₂ LASER SURGERY VIDEOS:
www.Aesculight.com/video/

About Dr. Gilsleider:
Dr. Ed Gilsleider is a 1982 graduate of Kansas State University. He has been in Claremore, Okla., in his mixed animal practice since graduation. He has been married to Lisa for 41 years, has four adult children and eight grandchildren.
New Publication on Preventive Care Protocols
AAHA (aaha.org) has released a new publication, *Implementing Preventive Care Protocols*, which was developed with the support of an educational grant from IDEXX (idexx.com). The publication builds on a previously released document, *Promoting Preventive Care Protocols: Evidence, Enactment, and Economics*, and includes tips on implementing preventive care protocols and guides for success, including developing pet owner communication and preparing for implementation of new preventive care protocols. The publication also includes findings from a study that examined canine wellness profiles run at IDEXX Reference Laboratories. The publication can be found at bit.ly/2kHEFjt—Press Release 9/2019

New Predictive Diagnostic Tool
Antech Diagnostics (antechdiagnostics.com) has introduced RenalTech, a predictive diagnostic tool that uses artificial intelligence, machine learning, and data from >150,000 cat examinations over the last 20 years to predict chronic kidney disease in cats 2 years before disease onset. RenalTech has a 95% accuracy in predicting disease that can help clinicians develop a personalized patient care plan. RenalTech can be applied to any standard serum chemistry profile conducted during an annual examination and relies on 7 common feline health measurements (ie, creatinine, BUN, WBC count, urine specific gravity, urine protein, urine pH, approximate age) to deliver a RenalTech status.—Press Release 9/2019

Up & Running Dental Promotion
Midmark Animal Health (midmark.com) has launched its *Up and Running* 2019 promotion. Now through December 31, clinicians and veterinary facilities can receive incentives on select veterinary dentistry equipment. During the Up and Running promotion, Midmark will offer a $350 rebate on the Midmark 1000 Dental Delivery System. For more information on the promotion, visit midmark.com/up—Press Release 9/2019

Program Initiated to Cure Canine Hemangiosarcoma
Ethos Discovery (ethosvet.com) has announced its plan to deliver curative outcomes for dogs with splenic hemangiosarcoma through a combination of genomic and precision medicine and aligned prospective clinical trials collectively named ePUSH (Ethos Precision Medicine Umbrella Study for Hemangiosarcoma). Ethos has opened the first clinical trial that will provide data to support ePUSH by assessing the combination of conventional chemotherapy (ie, doxorubicin) with a targeted cancer therapy (ie, rapamycin) in dogs following splenectomy for splenic hemangiosarcoma. This umbrella study will involve randomizing patients with canine hemangiosarcoma to drugs, defined by cancer genotype, and then monitoring outcomes prospectively. Desired curative outcomes from ePUSH are expected after the conclusion of this 5-year project.—Press Release 8/2019
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1. **MANAGEMENT TREE** **PAGE 12**
   Which of the following would *not* be suitable to use in cases of otitis when the eardrum is ruptured?
   A. Aqueous topical gentamicin
   B. N-acetylcysteine
   C. Tris-EDTA
   D. 0.2% chlorhexidine

2. **CONSULT THE EXPERT** **PAGE 25**
   Which of the following statements regarding disseminated intravascular coagulation (DIC) is false?
   A. DIC is a continuum initiated by a prothrombotic, hypercoagulable condition.
   B. DIC has a 100% mortality rate.
   C. Making a diagnosis of DIC can be challenging.
   D. DIC can occur in several phases, including subclinical.

3. **CASE IN POINT** **PAGE 31**
   Which of the following statements regarding the diagnosis of GI bleeding in small animal patients is false?
   A. Fecal occult blood testing can increase the index of suspicion for GI bleeding.
   B. Fecal occult blood testing is associated with low specificity.
   C. Video capsule endoscopy can help confirm GI bleeding.
   D. Video capsule endoscopy can be used in all dogs and cats that weigh >5 lb.

4. **PROCEDURES PRO** **PAGE 58**
   When a patient is clipped for exploratory celiotomy, the clipping should extend from _______ cranial to the xiphoid to _______ caudal to the cranial brim of the pubis.
   A. ≈1 cm, ≈1 cm
   B. ≈2 cm, ≈2 cm
   C. ≈3 cm, ≈3 cm
   D. ≈4 cm, ≈4 cm

5. **CASE IN POINT** **PAGE 66**
   Septic shock is defined as an infection associated with systemic hypotension that occurs despite adequate fluid resuscitation and requires use of vasopressors to maintain a mean arterial blood pressure _______.
   A. ≥45 mm Hg
   B. ≥55 mm Hg
   C. ≥65 mm Hg
   D. ≥75 mm Hg

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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.

**QUIZ CORNER**

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   - A. ≥45 mm Hg
   - B. ≥55 mm Hg
   - C. ≥65 mm Hg
   - D. ≥75 mm Hg

**Answer Key:**
1: D 2: B 3: D 4: D 5: C
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Dogs have long been recognized as a source of emotional support and valued members of our communities, but the way we interact with dogs in society has changed dramatically in just a few decades.

Pet dogs are now welcome at many hotels, outdoor restaurants, and even some retail stores, and cities across the United States have built recreational parks wholly dedicated to the play of dogs and the owners that care for them. Many owners secure dog day care so their pets are not left at home alone while they are at work, and routine, standing grooming appointments are commonplace. Current estimates indicate that more than 80% of dog owners permit their dog in the bedroom, over 75% allow the dog to lick their face, and 21% to 56% sleep with the dog in the bed.\(^1\)\(^2\) While dogs and owners usually benefit from the enriched social interactions these advances in the lifestyle of the modern dog have allowed, this close relationship creates some challenges.

Shared premises like dog parks, dog day cares, kennels, and pet-friendly public spaces bring dogs of many different backgrounds together, potentially facilitating transmission of parasites and other infections. Estimates from regional studies in Europe and the United States suggest that intestinal parasites, many of which are zoonotic, are present in 7.0% to 50.2% of fecal samples from dogs frequenting dog parks.\(^3\)\(^5\) However, most dog parks do not require any documentation of care prior to using the area, preferring a “use at your own risk” approach. The high prevalence of parasitism seen in the few studies available suggests that dogs visiting dog parks could be at increased risk of infection from exposure to a contaminated environment.
Most common canine intestinal helminths can be readily controlled with use of monthly products. However, adherence rates and use practices appear to vary widely among dog owners. An estimated 40% to 52% of dogs that visit the veterinarian remain completely unprotected from internal parasites, including heartworm and intestinal parasites, and only a minority of dogs receive the recommended 12 months of protection each year.\textsuperscript{6,7} Moreover, most common companion animal internal parasite preventives have been in use in veterinary medicine for decades, and some populations of parasites are now resistant.\textsuperscript{8,9} The dual challenges of increased infection opportunities and waning efficacy of some control products makes understanding and effectively controlling canine intestinal parasites more important than ever. In this review, we describe strategies to manage the veterinary and public health risks posed by canine intestinal helminths given the evolving role of dogs in society.

**Important Intestinal Helminths of Dogs**

**Cestodes**

Although common, infection with tapeworms is difficult to identify by fecal examination because eggs are only intermittently present, heavy, and not readily recovered for microscopic identification. Thus, if dogs are not shedding large numbers of proglottids, cestodes are often overlooked; antigen tests for tapeworms could address this diagnostic limitation but are not yet commercially available. *Dipylidium caninum*, the flea tapeworm (Figure 1), is usually transmitted by ingestion of an infected cat flea, *Ctenocephalides felis*. In areas of the United States where fleas are common, recent data indicates that almost 50% of dogs may be infected, and we now know dogs and cats are infected with distinct species of *D caninum*.\textsuperscript{10,11} Gravid proglottids are passed in the feces of an infected dog.

**FIGURE 1** Adult *Dipylidium caninum*, the flea tapeworm, live in the small intestine of dogs. While not considered to be a significant cause of clinical disease, motile proglottids may be found in the feces or in areas where the dog has recently rested, negatively impacting the human–animal bond. Figures 1 & 2 courtesy the National Center for Veterinary Parasitology (ncvetp.org)

**FIGURE 2** The scolex of *Taenia* spp has four suckers and a stout rostellum with prominent hooks to anchor the worms to the intestinal mucosa.
pet and the eggs are ingested by larval fleas, where the cestodes develop to the infective cysticercoid stage as the flea develops to an adult. *Taenia pisiformis* (Figure 2), *T hydatigena*, and a few other *Taenia* spp are transmitted to dogs when they ingest immature stages in herbivore intermediate hosts. Recent studies estimate that 5% to 10% of dogs in the central United States are infected with *Taenia* spp although prevalence has reportedly been greater—as much as 25%—in previous surveys. When found on fecal examination, the brown, hexacanth eggs of *Taenia* spp are morphologically identical to those of *Echinococcus* spp, a less commonly reported cestode of pets. In recent years, *Echinococcus* spp have become increasingly recognized in some areas of Canada. Although apparently rare in the United States, adult *Echinococcus* spp are very small (Figure 3) and may be overlooked. *Echinococcus* spp infections in pets can have severe implications for veterinary and public health (see Health Risk Posed to Dogs & Humans). Flea control and preventing predation are key to avoiding reinfection with cestodes.

**Nematodes**

Most nematode infections are readily identified by fecal testing although fecal flotation alone can miss 15% to more than 40% of infections in adult dogs. *Ancylostoma caninum*, the canine hookworm (Figure 4A), is the most commonly reported gastrointestinal nematode of dogs and infects as many as 46.4% of dogs in animal shelters although prevalence in pet dogs, as estimated by detection of eggs in feces, is much lower. *Uncinaria stenocephala* (Figure 4B) occurs much less commonly and is largely non-pathogenic. Hookworm eggs are passed in the feces of infected dogs and then mature over approximately the next week to infective third stage larvae. Infective hookworm larvae can persist in the environment for a month or more, creating an infection risk to dogs and people. Recent surveys suggest the canine whipworm, *Trichuris vulpis* (Figure 5), is present in as many as 39.2% of shelter dogs. Detecting the heavier eggs of *T vulpis* in fecal samples can be challenging, and infections are often overlooked. *Toxocara canis* (Figure 6) is most commonly identified in pups although as many as 10% to 15% of adult shelter dogs may be infected. Larvated, infectious eggs of both whipworms and ascarids can remain viable for many years, creating a source for reinfection of dogs that ingest soil or soil-contaminated objects like tennis balls or other toys.

**Health Risk Posed to Dogs & Humans**

**Risks to Dogs**

Dogs of all ages are at risk for intestinal helminths. Ascarids and associated clinical disease are most

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**FIGURE 3** Adult *Echinococcus* spp are only a few millimeters long. If careful sieving of the intestinal contents is not performed, this parasite can be readily overlooked.

**FIGURE 4** Hookworms take their name from the bent anterior end. The stoma of *Ancylostoma caninum* (A) bears 3 pairs of teeth used to lacerate the intestinal mucosa while that of *Uncinaria stenocephala* (B) has cutting plates. Figure 4 courtesy the National Center for Veterinary Parasitology (ncvetp.org)
common in young pups while hookworms and whipworms are more common in older pups and young adult dogs, particularly those with frequent access to parasite-laden environments. However, tapeworms may be present in dogs of any age. Clinical disease due to adult *Taenia* spp, *Echinococcus* spp, or *D caninum* in the small intestine is considered uncommon, but some tapeworm-infected dogs may present with anal pruritus, and a few reports describe intestinal impaction due to massive *Taenia* spp infections. When dogs serve as the definitive host of *E multilocularis*, eggs are passed in the feces. If eggs are ingested during self-grooming, dogs can become an aberrant intermediate host and may develop aggressively metastasizing hemorrhagic masses of immature cestodes in the liver, lungs, or other organs. Although canine *E multilocularis* infection is increasingly reported in Canada, recognized cases are rare in the United States.

Nematodes also cause disease in dogs. Feeding by immature and adult *A caninum* results in blood loss usually accompanied by diarrhea; when infection intensity is high, massive hemorrhagic anemia can result, especially in young dogs. In contrast, *U stenocephala* is thought to cause only 1% to 2% of the blood loss caused by *A caninum*; thus, infections caused by the “northern hookworm” are rarely associated with disease. Whipworms also cause diarrhea, with feces often containing fresh blood. Heavy infection with *T vulpis* can lead to electrolyte imbalance that presents as pseudohypoadrenocorticism and resolves following treatment for *T vulpis*. Disease due to *T canis* is most often seen in pups infected early in life and results in ill-thrift and a classic “pot-bellied” appearance; severe infections in very young pups may be fatal. Adult dogs are less likely to show clinical signs associated with *T canis* infection, but left untreated, these silent infections can result in massive environmental

Occasionally, *A caninum* larvae migrate and mature to adults in the small intestine of people causing eosinophilic enteritis.
contamination with ascarid eggs. Risk for infection and subsequent disease from nematodes is greatest when dogs come in contact with environments where other dogs frequently defecate, such as dog parks, which are likely to contain infective third-stage larvae of hookworms or larvated eggs of whipworms or ascarids.

**Risks to Humans**

Most canine intestinal helminths pose some zoonotic risk although severity of resultant human disease varies. People, usually children, become infected with *D. caninum* when they ingest an infected flea and develop adult tapeworms in the small intestine. Ingestion of taeniid eggs can result in development of cysticerci or, if *Echinococcus* spp are involved, severe disease due to formation of hydatid cysts. Larvae of *A. caninum* directly penetrate the skin of people leading to cutaneous larva migrans; lesions are intensely pruritic and most commonly develop on the hands, feet, and back of the legs. In one outbreak, 22 individuals at a children’s summer camp in Florida developed lesions after contact with a contaminated sandbox. Occasionally, *A. caninum* larvae migrate and mature to adults in the small intestine of people causing eosinophilic enteritis. Ingestion of larvated eggs of *T. canis* can lead to ocular and visceral larva migrans which can manifest as retinitis or hepatomegaly and pulmonary disease, respectively. Additionally, covert toxocariasis can lead to development of chronic abdominal pain. Within the United States, 13.9% of people are seropositive for *T. canis*. Ingestion of larvated eggs of *Baylisascaris procyonis*, a raccoon ascarid occasionally found in dogs, can result in severe, progressive neurologic disease. Although limited reports describe human infection with *T. vulpis*, the identity of the nematodes were not confirmed molecularly and canine whipworms are not regarded as zoonotic.

**Routine Deworming to Limit Infections**

Veterinary and public health organizations like the Companion Animal Parasite Council (capcvet.org) and Centers for Disease Control and Prevention (cdc.gov) advise that all dogs should be routinely dewormed year-round for intestinal helminths because of the high risk for infection and disease that parasites pose. Monthly heartworm preventives marketed in the United States are also dewormers, with label-approved efficacy as treatments for hookworms, ascarids, and, in the case of oral milbemycin oxime or transdermal moxidectin, whipworms. Heartworm preventives that contain praziquantel are approved treatments for common tapeworms including *D. caninum*, *Taenia* spp, and *Echinococcus* spp (*Table*). For example, in northern Europe, a milbemycin oxime–praziquantel combination is used to treat canine hookworm, ascarid, and tapeworm infections. **Figure 6**

**Figure 6** Adult *Toxocara canis* are the largest of the common canine gastrointestinal parasites. Heavy burdens in pups can result in ill thrift and stunting, but infections in adult dogs are often subclinical. When untreated, these silent infections can allow long-term environmental contamination with eggs. **Figure 6 courtesy the National Center for Veterinary Parasitology (ncvetp.org)**
formulation is used in dogs as a dewormer even in areas where heartworm is not endemic; in the United States, the same formulation is widely used as a heartworm preventive that also treats intestinal nematodes and cestodes.

Compounds and formulations that in the United States are commonly referred to as “heartworm preventives” often protect dogs from more than just heartworm disease, but specific efficacy of the different products varies (Table). Injectable moxidectin prevents heartworm infection for 6 or 12 months, and treats hookworms when administered, but does not prevent hookworm infection for the full 6- to 12-month treatment period, and is not effective for ascarids or whipworms. Similarly, monthly ivermectin–pyrantel parasite control products treat hookworms and ascarids when administered but do not have efficacy against whipworms. Pyrantel-resistant populations of *A caninum* have long been recognized in greyhounds, and recent data suggest additional resistance issues may limit the utility of several dewormers, including pyrantel, ivermectin, and thiabendazole, against certain populations of *A caninum*.

**Other Strategies to Prevent Infections**

Dog management to limit parasite infection risk is also helpful in protecting canine and human health. Canine feces should be promptly disposed of with municipal waste whether it is deposited on a sidewalk, at the dog park, or in the owners’ backyard. Larvae of *A caninum* are most likely to develop and transmit to other dogs (and to people) in a warm, humid environment, so spring and summer pose the greatest risk. In contrast, infective eggs of *T canis* and *T vulpis* are able to survive through the winter months, presenting year-round opportunities for infection. Effective flea control all but eliminates the risk for *D caninum* infection, and restricting roaming to prevent dogs from scavenging or preying on wildlife reduces...
Taenia spp and Echinococcus spp infection. Dogs that frequent shared facilities like dog parks, dog day care, groomers, or boarding kennels will benefit from additional vigilance regarding parasite control.

Responsible kennels and groomers often require evidence of parasite prevention and testing—in addition to vaccination—prior to accepting dogs. Groups like CAPC recommend that any dogs using shared facilities be current on parasite control and have a recent heartworm test and fecal examination for parasites, an approach that protects both canine and human health since some common canine infections are potentially zoonotic. Because compliance may be less than ideal, resistance can develop, and all products are not effective against all parasites of importance, fecal testing for intestinal parasites is recommended every 6 to 12 months, even for dogs that routinely receive parasite control products (Figure 7). Dog owners should be encouraged to inquire about parasite control practices and consider avoiding areas with open-access policies that may be frequented by unvaccinated dogs or those not on parasite control products. Dogs that frequent dog parks or other areas where pets from varied backgrounds mingle may benefit from more frequent (eg, quarterly) testing.

**Conclusion**

Effective parasite control efforts, including strategies that limit canine intestinal parasites with zoonotic potential, remain critically important for protecting the human–animal bond and ensuring that dogs and people continue to enjoy a close, healthy relationship. The success of parasite control in companion animal medicine in the United States has resulted in a relatively low prevalence of parasite infection and subsequent clinical disease in well-cared-for adult pet dogs, with national data indicating that parasites are detected in fecal samples from 29.6% of dogs less than 6 months of age but only 6.1% of dogs over 1 year of age. However, that success, which is the result of decades of focused effort, can create a false sense of security that intestinal parasites are no longer a major concern for pet dogs. As those who work with shelter or rescue dogs can attest, the risk of intestinal parasites has not been eliminated. Parasites remain in contaminated soil, water untreated domestic dogs, and wildlife hosts across the United States, making consistent parasite preventive use critical.

**FDA label-approved spectrum of efficacy of active ingredient combinations present in parasite control products used to prevent heartworm infection and treat and control intestinal helminths in dogs. All products listed are approved heartworm preventives in the United States.**

<table>
<thead>
<tr>
<th>Parasite control product</th>
<th>Route</th>
<th>Frequency of administration</th>
<th>Intestinal parasite control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ivermectin–pyrantel</td>
<td>Oral</td>
<td>Monthly</td>
<td>Hookworms, ascarids</td>
</tr>
<tr>
<td>Ivermectin–pyrantel–praziquantel</td>
<td>Oral</td>
<td>Monthly</td>
<td>Hookworms, ascarids, cestodes</td>
</tr>
<tr>
<td>Milbemycin oxime</td>
<td>Oral</td>
<td>Monthly</td>
<td>Hookworms, ascarids, whipworms</td>
</tr>
<tr>
<td>Milbemycin oxime–praziquantel</td>
<td>Oral</td>
<td>Monthly</td>
<td>Hookworms, ascarids, whipworms, cestodes</td>
</tr>
<tr>
<td>Moxidectin</td>
<td>Transdermal</td>
<td>Monthly</td>
<td>Hookworms, ascarids, whipworms</td>
</tr>
<tr>
<td>Moxidectin</td>
<td>Subcutaneous injection</td>
<td>Every 6 months or every 12 months depending on formulation</td>
<td>Hookworms present when injection administered</td>
</tr>
<tr>
<td>Selamectin</td>
<td>Transdermal</td>
<td>Monthly</td>
<td>None</td>
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</tbody>
</table>
REFERENCES