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IN THIS ISSUE

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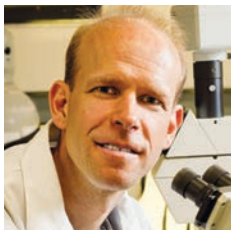

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WE ASKED . . .

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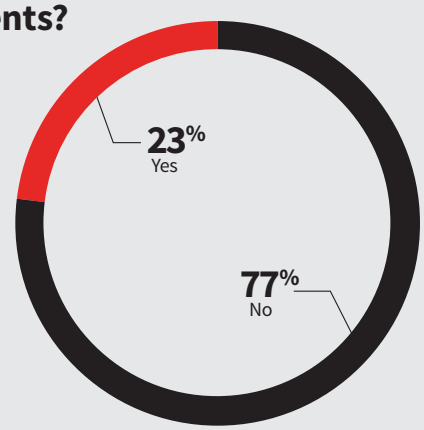
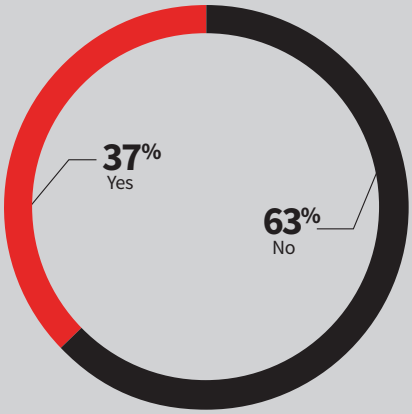


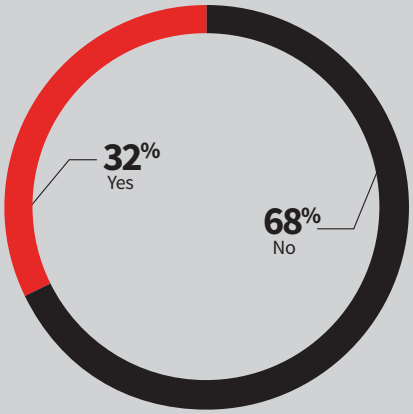
"The clinic I work at has had success using it, even with cats."—*Kim T*

Do you report all vaccine reactions to the manufacturer?



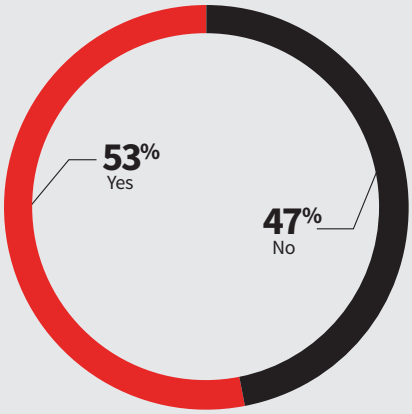
"All? Absolutely not. Pain at the injection site and lethargy are considered vaccine reactions. Certain reactions, such as angioneurotic edema or hives? Absolutely."—*Darren R*

Does your clinic have a veterinary nurse or assistant assigned to a specific clinician each day?



"We typically have 2 nurses assigned per clinician, and they rotate daily. Schedules are posted at the beginning of the week and adjustments made as needed based on case load."—*Susan R*

Do your clients prepay for diagnostic tests (eg, fecal testing) and bring the sample to the clinic later?



"Very rarely."—*Stephanie W*

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DIFFERENTIAL DIAGNOSIS PAGE 35

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IMAGE GALLERY PAGE 18

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IMAGE GALLERY PAGE 57

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CONSULT THE EXPERTS PAGE 26

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Continues on page 25

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See page 5 for product information summary.

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David Eshar, DVM, DABVP (ECM), DECZM (SM & ZHM)

PG 18

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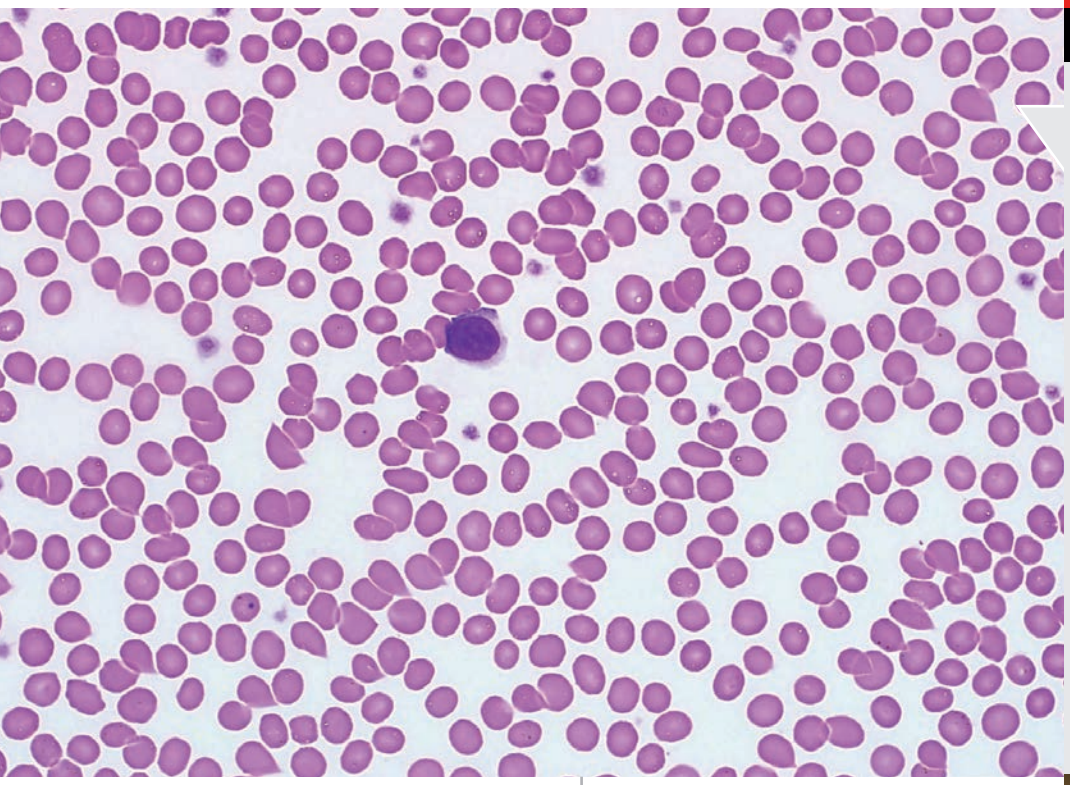

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Top 5 Complications of Gonadectomy

Karen M. Tobias, DVM, MS, DACVS
University of Tennessee

▲ **FIGURE 1** Incisional infection and dehiscence after OHE in a dog (patient orientation, head left)

Gonadectomy (ie, ovariohysterectomy [OHE] or neutering) is one of the most commonly performed veterinary surgical procedures.[1-6] Gonadectomy reduces pet overpopulation and euthanasia in animal shelters and decreases the risk for gonadal tumors, mammary neoplasia and pyometra in dams and queens, and perianal adenomas and benign prostatic hyperplasia in male dogs.[7] It may also increase longevity and reduce hormonally driven behavior.[7]

Although gonadectomy is considered a routine procedure, complications can arise. Following are 5 of the most common complications of gonadectomy according to the author.

1 Incisional Complications

Incisional inflammation is an expected effect of any surgery and typically resolves without treatment[8]; incisional complications, however, occur less frequently[1] and are likely underreported, as clinicians may not closely evaluate the incision line after anesthetic recovery or may not record findings they consider expected, minor, or self-limiting. Incisional complications associated with gonadectomy can include incisional and/or scrotal swelling, pain, redness, seromas, hernias, peri-incisional dermatitis, and skin bruising and generally occur more frequently in dogs >50 lb (22.7 kg) and in cats.[4,9-11]

TOP 5 COMPLICATIONS OF GONADECTOMY

1. Incisional Complications
2. Intra-Abdominal Hemorrhage
3. Postoperative Pain
4. Surgical Errors
5. Hormonal Changes

OHE = ovariohysterectomy

Incision location may affect complication rates. For example, in a study of kittens undergoing OHE, incisional complications occurred more commonly with a midline approach as compared with a flank approach.[12] In a study of dogs, prescrotal neuters resulted in a higher rate of self-trauma than did scrotal neuters,[11] which may be attributed to scrotal neuters being performed without suture closure, thus lessening the amount of tissue handling.[10,11]

Surgical-site infections and other serious wound complications that are suggestive of infection (eg, wound pain and swelling, dehiscence, drainage; ***Figure 1***) have been reported in 0.1% to 3% of elective gonadectomies.[1,2,4,13] This rate is similar to the infection rates reported for clean, elective procedures in general (2.3%-5.7%).[14] Infection rates can be reduced by decreasing surgery duration and using appropriate surgical technique (eg, gentle tissue handling, closure of dead space).[14,15]

2 Intra-Abdominal Hemorrhage

Intraoperative hemorrhage is noted in 1.1% to 11% of dogs and cats undergoing gonadectomy and is most common in dogs >50 lb (22.7 kg) or when the surgery is performed by students.[1,4,16] Postoperative abdominal hemorrhage is noted in ≤2.8% of patients undergoing gonadectomy.[4] Rough tissue handling, poor ligation technique, inexperience, and inadequate exposure may play a role in intra-abdominal hemorrhage. Cats undergoing gonadectomy are less likely to experience intra-abdominal hemorrhage than are dogs, even if ligatures are not used for ovarian pedicle hemostasis, as feline ovarian pedicles are generally small, less vascular, and more mobile as compared with canine ovarian pedicles. In a study of 2136 cats undergoing pedicle tie OHE, 0.28% of cats experienced intra-abdominal hemorrhage[17]; most cases were recognized and corrected during the procedure. In that study, uterine pedicle hemorrhage was noted in 0.14% of cats, and suspensory ligament hemorrhage was noted in 0.05% of cats.

Another source of intra-abdominal hemorrhage is splenic laceration, which can be caused by laparoscopic equipment or excessive spay hook use.[18]

Fatal abdominal hemorrhage from OHE or ovariectomy is rare, as most hemorrhaging is noted and addressed prior to closure.[1,4,16,17] Patients with significant postoperative hemorrhage may have nonspecific signs (eg, slow anesthetic recovery, tachycardia, hypothermia, pale mucous membranes). Diagnosis is made via abdominal ultrasonography and abdominocentesis. In clinics without ultrasonography equipment, 4-quadrant abdominocentesis can be performed if the falciform ligament, which will block the needle, and spleen are avoided. Nonclotting blood on abdominocentesis confirms the diagnosis of hemoabdomen.[19] If significant abdominal hemorrhage is detected, coagulation tests should be considered. The clinician must decide whether to treat the patient conservatively (eg, abdominal bandaging, sedation, monitoring, judicious use of fluids) or perform exploratory surgery. If surgery is chosen, the incision should be extended to provide adequate exposure, and the ovarian pedicles, suspensory ligaments, uterine stump, and other organs should be closely evaluated. If bleeding is identified, the tissue in question should be gently elevated from underlying structures with thumb forceps before the vessels are clamped and ligated. Transected ovarian pedicles commonly retract caudomedial to the kidneys and may rest immediately over the ureters. In cats, the distal ureters lie close to the uterine stump. Regardless of location,

Rough tissue handling, poor ligation technique, inexperience, and inadequate exposure may play a role in intra-abdominal hemorrhage.

the ureters can be inadvertently ligated. If no active hemorrhage is observed during surgery, all pedicles should be ligated again, as anesthetic hypotension may mask vessel leakage.

Serious hemorrhage from gonadectomy is rare, but bleeding can occur from the incision or, in dogs undergoing prescrotal neutering, in the scrotum. In one study of scrotal and prescrotal neutering in 437 dogs >6 months of age, hemorrhage was observed in 16% of all dogs.[11] Bleeding occurred more commonly in larger dogs, and surgical approach was not a factor in its occurrence.[11] In another study of scrotal neutering with sutureless pedicle ties in dogs <6 months of age, no postoperative hemorrhage was noted.[10] Hemorrhage after neutering is often related to bleeding from the tunics or SC tissue and is usually self-limiting.[14] Affected patients can be treated with local pressure (dogs, scrotum; cats, scrotum or inguinal ring), cold packs, sedation, and exercise restriction and monitored for significant changes in hematocrit. Dogs with severe scrotal hematomas may develop abscessation or scrotal necrosis necessitating scrotal ablation. In rare cases, testicular vessels can retract through the inguinal ring into the peritoneal cavity, resulting in intra-abdominal hemorrhage. In these patients, clinical signs and treatment are similar to those in patients with postoperative hemorrhage after OHE.

3 Postoperative Pain

Some clinicians consider postoperative pain a normal effect of surgery. In one study, ≤12% of clinicians did not administer any postoperative analgesics to their patients, and many others relied on butorphanol, which may provide insufficient analgesia.[3] Most retrospective studies of elective gonadectomy do not list pain as a potential surgical complication, and dogs undergoing routine gonadectomy are less likely to be prescribed postoperative analgesics than those undergoing other surgeries.[1,2,9,12,20]

OHE = ovariohysterectomy
ORS = ovarian remnant syndrome

Inadequate treatment of postoperative pain may be due to generational or gender differences among clinicians, cost or regulatory concerns, lack of access to appropriate drugs, and/or insufficient knowledge of pharmacology or pain detection in various species. For example, pain in cats tends to be undertreated because cats rarely show signs of pain after elective procedures.[21] However, when mechanical nociceptor threshold (scrotal pressure tolerance) was measured in a study of cats after neutering, cats often reacted for ≥8 hours after surgery.[21] In another study, cats exhibited decreased tolerance to abdominal palpation 18 hours after OHE but appeared pain free on visual assessment.[22]

Prolonged pain has also been noted in gonadectomized dogs. In one study, abdominal palpation and pain scores had not returned to normal by 72 hours after OHE.[8] In another study, when pain was closely monitored after neutering, ≈50% of dogs required rescue analgesia within 3 to 4 hours of receiving preoperative morphine.[23] Owners may note patient discomfort in dogs in the form of lethargy, restlessness, vocalization, and/or decreased appetite 1 to 3 days after gonadectomy.[20,24]

Clinicians should consider pre-emptive analgesics (eg, local or regional nerve blocks) and administer rescue opioids while the patient is being monitored in the clinical setting.[3,25] Analgesics should also be prescribed for several days after the procedure.

4 Surgical Errors

Reported surgical errors include incomplete ovariectomy, pedicle granulomas and fistulas from use of nonabsorbable multifilament suture or nylon cable ties, inadvertent ureteral ligation, incisional hernias, retained surgical sponges or other foreign bodies (ie, gossypibomas), and inadvertent prostatectomy during cryptorchidectomy.[1,14] The author has also seen uterine horns inadvertently tied together around the colon or urethra, resulting in stricture or obstruction. The exact incidence of surgical errors during elective gonadectomy is unknown. As with intra-abdominal

hemorrhage, surgical errors can occur from inexperience or lack of sufficient anatomic exposure.

Ovarian remnant syndrome (ORS) occurs when functional ovarian tissue is inadvertently left in the patient (***Figure 2***).[14] Patients with ovarian remnants are often overweight or have been spayed through a small incision, both of which can interfere with ovary visualization and appropriate clamp or ligature placement.[1] Affected patients may display signs of estrus (eg, mammary or vulvar enlargement, behavior changes, vulvar discharge) or become clinically ill due to stump pyometra. Diagnosis of ORS is based on elevated concentrations of anti-Müllerian hormone and progesterone in peripheral blood.[26] Treatment includes exploratory celiotomy, ovariectomy, and/or, if stump pyometra is present, removal of the uterus. Retained ovarian remnants are easier to locate when the patient is showing signs of estrus, as associated vessels will be enlarged and cystic follicles may be present in retained tissue.[14]

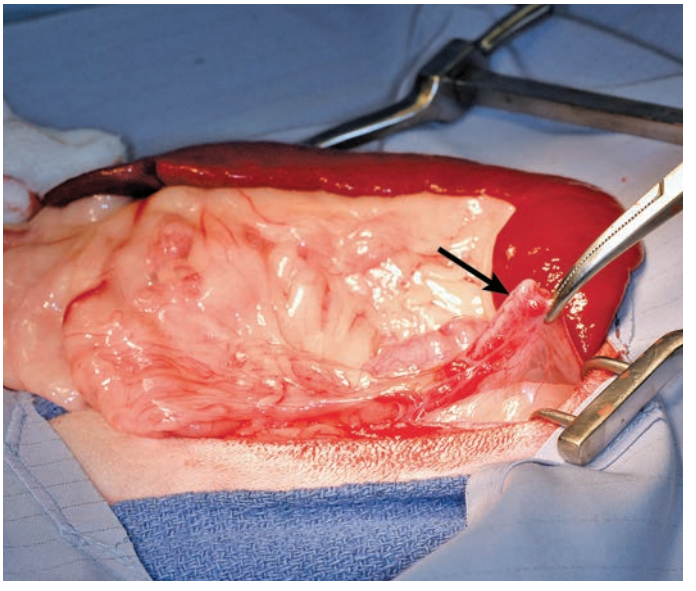
Inadvertent prostatectomy during removal of a cryptorchid testicle can also result from inadequate exposure, in which the clinician incorrectly identifies the almond-shaped prostate as a retained intra-abdominal testicle without noting the attached bladder and urethra. The author has witnessed students inadvertently expose the prostate through an abdominal incision when using a spay hook in attempt to locate a retained testicle. Dogs that have undergone inadvertent prostatectomy will have azotemia and anuria from urethral transection and ligation; subsequent bladder necrosis from overdistension can result in uroabdomen. Some dogs will regain urinary continence with surgical reanastomosis of the urethra.[27]

Retained surgical sponges can become walled off and cause no clinical signs for years; alternatively, affected patients may develop clinical signs as a result of adhesions, mass effect, fistulas or sinus tracts, vessel or visceral erosion, infection, or neoplastic transformation.[28,29] Diagnosis can be difficult if a radiopaque marker is not present in the sponge, although the mass is usually evident on ultrasonography or CT. Treatment entails surgical removal of the sponge, in which careful dissection is required to prevent damage to local structures.[29] Institution of sponge counts before and after each abdominal surgery can help decrease the risk for gossypibomas.

Ventral midline hernias occur in <1% of patients undergoing OHE.[1,2,13,14] If the hernia is present within the first week after surgery, it is likely the result of technical error (eg, missed external rectus fascia, inappropriate suture size, suture bites that are too small or too far apart, knot failure).[1,14]

5 Hormonal Changes

Gonadectomy is common in the United States due to its value in surgical sterilization and preventing or reducing reproductive diseases (eg, benign prostatic hyperplasia, testicular tumors, pyometra, mammary neoplasia) and sexually driven behaviors.[7] Adoption rates of shelter dogs are often increased with preadoption gonadectomy; however, evidence of its potential negative effects has been accumulating.[7,30-40]



▲ **FIGURE 2** Retained left ovary (***arrow***) in a cat with behavioral signs of estrus 6 months after OHE (patient orientation, head right)

Gonadectomy has been correlated with obesity in dogs and cats,[30-32] which may result from changes in fasting metabolic rate (as has been noted in female cats), increased food intake, and/or decreased activity.[31,32] Obesity may increase the risk for or exacerbate osteoarthritis and/or other systemic illnesses. Owners should be instructed on how to adjust activity levels and food intake to maintain their pet's ideal body condition.

Another condition associated with neuter status is urinary incontinence in female dogs.[33] Urinary incontinence is rare in intact bitches (0%-1%) but reportedly occurs in 5% to 20% of spayed female dogs.[7,33,39,40] The risk appears to be greatest in dogs >33 lb (15 kg).[40] Some studies have reported correlations with the dog's age at the time of OHE, whereas others have found no significant effects.[39-41] Signs of urinary incontinence can manifest as early as 4 weeks postoperation or may be delayed for 3 to 10 years.[24,33] The pathophysiology of this acquired sphincter mechanism incompetence is unclear. Small-breed female dogs may have a greater risk for pyometra and mammary tumors than urinary incontinence; thus, the benefits of OHE before the first or second heat may outweigh the likelihood of complications.

Large- and giant-breed dogs, particularly golden retrievers, German shepherd dogs, and rottweilers, may be at greater risk for morbidity and mortality from joint disease, neoplasia, and urinary incontinence resulting from gonadectomy at a young age. Gonadectomy has been shown to increase the incidence of joint disorders in large-breed dogs by 2 to 5 times that of intact dogs, especially when performed in dogs <6 months of age.[7,34,35] For example, in one study, the incidence of joint disorders was 5% in intact adult male golden retrievers as compared with 27% in those neutered before 6 months of age.[34] In another study, joint disorders were diagnosed in 21% and 16% of male and female German shepherd dogs, respectively, gonadectomized at <1 year of age as compared with 7% and 5% of intact male and female German shepherd dogs, respectively.[35]

Gonadectomy has been shown to increase the incidence of joint disorders in large-breed dogs by 2 to 5 times that of intact dogs.

OHE = ovariohysterectomy

Gonadectomy may also be associated with an increased risk for certain cancers in large-breed dogs, although controlled studies are lacking. In one study of 683 rottweilers, bone sarcoma was diagnosed in 12.6% of dogs[36]; the risk for development of bone sarcomas was >3 times greater in dogs gonadectomized before 1 year of age. In other breeds, cancer-related deaths may be increased because gonadectomized animals live longer.[7] Delaying gonadectomy until physical maturity (eg, >12 months of age) may be beneficial for large-breed dogs, although delaying surgery increases the risk for wound complications and surgical errors, likelihood of greater costs due to increased surgical time and anesthesia, and potential for unwanted litters before sterilization.

Because cats do not appear to experience many long-term ill effects from gonadectomy, other than the potential for obesity, prepubertal gonadectomy is usually considered acceptable for this species.[37] However, gonadectomy in animals <7 months of age will delay physeal closure, which could increase the risk for physeal fractures in male cats, particularly if they become obese.[42]

Clinicians must weigh the risks and benefits of gonadectomy with the pet owner and determine the most appropriate age to neuter different breeds and species.

References

1. Muraro L, White RS. Complications of ovariohysterectomy procedures performed in 1880 dogs. *Tierarztl Prax Ausg K Kleintiere Heimtiere.* 2014;42(5):297-302.
2. Pollari FL, Bonnett BN, Bamsey SC, Meek AH, Allen DG. Postoperative complications of elective surgeries in dogs and cats determined by examining electronic and paper medical records. *J Am Vet Med Assoc.* 1996;208(11):1882-1886.
3. Hewson CJ, Dohoo IR, Lemke KA. Perioperative use of analgesics in dogs and cats by Canadian veterinarians in 2001. *Can Vet J.* 2006;47(4): 352-359.
4. Berzon JL. Complications of elective ovariohysterectomies in the dog and cat at a teaching institution: clinical review of 853 cases. *Vet Surg.* 1979;8(3):89-91.
5. Warne LN, Robertson ID. A survey of veterinary consultations in Perth. *Aust Vet Pract.* 2003;33(1):33-36.
6. Wagner AE, Hellyer PW. Survey of anesthesia techniques and concerns in private veterinary practice. *J Am Vet Med Assoc.* 2000;217(11):1652-1657.
7. Howe LM. Current perspectives on the optimal age to spay/castrate dogs and cats. *Vet Med (Auckl).* 2015;6:171-180.
8. Hancock RB, Lanz OI, Waldron DR, Duncan RB, Broadstone RV, Hendrix PK. Comparison of postoperative pain after ovariohysterectomy by harmonic scalpel-assisted laparoscopy compared with median celiotomy and ligation in dogs. *Vet Surg.* 2005;34(3):273-282.
9. Snell WL, Orsher RJ, Larenza-Menzies MP, Popovitch CA. Comparision of caudal and pre-scrotal castration for management of perineal hernia in dogs between 2004 and 2014. *N Z Vet J.* 2015;63(5):272-275.
10. Miller KP, Rekers WL, DeTar LG, Blanchette JM, Milovancev M. Evaluation of sutureless scrotal castration for pediatric and juvenile dogs. *J Am Vet Med Assoc.* 2018;253(12):1589-1593.
11. Woodruff K, Rigdon-Brestle K, Bushby PA, Willits R, Huston C. Scrotal castration versus prescrotal castration in dogs. DVM360 website. http://veterinarymedicine.dvm360.com/scrotal-castration-versus-prescrotal-castration-dogs. Published May 2015. Accessed December 4, 2019.
12. Roberts ML, Beatty JA, Dhand NK, Barrs VR. Effect of age and surgical approach on perioperative wound complication following ovariohysterectomy in shelter-housed cats in Australia. *JFMS Open Rep.* 2015; 1(2):2055116915613358.
13. Kreisler RE, Shaver SL, Holmes JH. Outcomes of elective gonadectomy procedures performed on dogs and cats by veterinary students and shelter veterinarians in a shelter environment. *J Am Vet Med Assoc*. 2018;253(10):1294-1299.
14. Adin CA. Complications of ovariohysterectomy and orchiectomy in companion animals. *Vet Clin North Am Small Anim Pract.* 2011;41(5): 1023-1039.
15. Travis BM, Hayes GM, Vissio K, Harvey HJ, Flanders JA, Sumner JP. A quilting subcutaneous suture pattern to reduce seroma formation and pain 24 hours after midline celiotomy in dogs: a randomized controlled trial. *Vet Surg.* 2018;47(2):204-211.
16. Burrow R, Batchelor D, Cripps P. Complications observed during and after ovariohysterectomy of 142 bitches at a veterinary teaching hospital. *Vet Rec.* 2005;157(26):829-833.
17. Miller KP, Rekers W, Ellis K, Ellingsen K, Milovancev M. Pedicle ties provide a rapid and safe method for feline ovariohysterectomy. *J Feline Med Surg.* 2016;18(2):160-164.
18. Corriveau KM, Giuffrida MA, Mayhew PD, Runge JJ. Outcome of laparoscopic ovariectomy and laparoscopic-assisted ovariohysterectomy in dogs: 278 cases (2003-2013). *J Am Vet Med Assoc.* 2017;251(4):443-450.
19. Herold LV, Devey JJ, Kirby R. Clinical evaluation and management of hemoperitoneum in dogs. *J Vet Emerg Crit Care.* 2008;18(1):40-53.
20. Wagner AE, Worland GA, Glawe JC, Hellyer PW. Multicenter, randomized controlled trial of pain-related behaviors following routine neutering in dogs. *J Am Vet Med Assoc.* 2008;233(1):109-115.

Continues ▶

21. Slingsby LS, Jones A, Waterman-Pearson AE. Use of a new finger-mounted device to compare mechanical nociceptive thresholds in cats given pethidine or no medication after castration. *Res Vet Sci.* 2001;70(3):243-246.
22. Slingsby LS, Waterman-Pearson AE. Postoperative analgesia in the cat after ovariohysterectomy by use of carprofen, ketoprofen, meloxicam or tolfenamic adid. *J Small Anim Pract.* 2000;41(10):447-450.
23. Huuskonen V, Hughes JML, Estaca Bañon E, West E. Intratesticular lidocaine reduces the response to surgical castration in dogs. *Vet Anaesth Analg.* 2013;40(1):74-82.
24. Binder C, Katić N, Aurich JE, Dupré G. Postoperative complications and owner assessment of single portal laparoscopic ovariectomy in dogs. *Vet Rec.* 2018;183(24):745.
25. Quarterone C, Luna SPL, Crosignani N, et al. Ovariohysterectomy requires more post-operative analgesia than orchiectomy in dogs and cats. *Can Vet J.* 2017;58(11):1191-1194.
26. Cornell University College of Veterinary Medicine Animal Health Diagnostic Center. Canine reproductive function tests. Cornell University website. https://www.vet.cornell.edu/animal-health-diagnostic-center/testing/protocols/canine-reproductive-tests. Accessed December 4, 2019.
27. Schulz KS, Waldron DR, Smith MM, Henderson RA, Howe LM. Inadvertent prostatectomy as a complication of cryptorchidectomy in four dogs. *J Am Anim Hosp Assoc.* 1996;32(3):211-214.
28. Zeltman P, Downs MO. Surgical sponges in small animal surgery. *Compend Contin Educ Vet.* 2011;33(6):E5.
29. Papazoglou LG, Tsioli V, Patsikas VT, Kazakos GM. Retained surgical sponges. *Compend Contin Educ Pract Vet.* 2004;26(8):634-644.
30. Goh CSS. Age of neutering in large- & giant-breed dogs. *Clinician's Brief.* 2016;14(8):18-23.
31. Fettman MJ, Stanton CA, Banks LL, et al. Effects of neutering on bodyweight, metabolic rate and glucose tolerance of domestic cats. *Res Vet Sci.* 1997;62(2):131-136.
32. Bermingham EN, Thomas DG, Cave NJ, Morris PJ, Butterwick RF, German AJ. Energy requirements of adult dogs: a meta-analysis. *PLoS One.* 2014;9(10):e109681.
33. Arnold S, Hubler M, Reichler I. Urinary incontinence in spayed bitches: new insights into the pathophysiology and options for medical treatment. *Reprod Dom Anim.* 2009;44(Suppl 2):190-192.
34. Hart BL, Hart LA, Thigpen AP, Willits NH. Long-term health effects of neutering dogs: comparison of Labrador retrievers with golden retrievers. *PLoS One.* 2014;9(7):e102241.
35. Hart BL, Hart LA, Thigpen AP, Willits NH. Neutering of German shepherd dogs: associated joint disorders, cancers and urinary incontinence. *Vet Med Sci.* 2016;2(3):191-199.
36. Cooley DM, Beranek BC, Schlittle DL, Glickman NW, Glickman LT, Waters DJ. Endogenous gonadal hormone exposure and bone sarcoma risk. *Cancer Epidemiol Biomark Prev.* 2002;11(11):1434-1440.
37. Porters N, Polis I, Moons CPH, et al. Relationship between age at gonadectomy and health problems in kittens adopted from shelters. *Vet Rec.* 2015;176(22):572.
38. Clevenger J, Kass PH. Determinants of adoption and euthanasia of shelter dogs spayed or neutered in the university of California veterinary student surgery program compared to other shelter dogs. *J Vet Med Educ*. 2003;30(4):372-378.
39. Beauvais W, Cardwell JM, Brodbelt DC. The effect of neutering on the risk of urinary incontinence in bitches – a systematic review. *J Small Anim Pract*. 2012;53(4):198-204.
40. Forsee KM, Davis GJ, Mouat EE, Salmeri KR, Bastian RP. Evaluation of the prevalence of urinary incontinence in spayed female dogs: 566 cases (2003-2008). *J Am Vet Med Assoc.* 2013;242(7):959-962.
41. Spain CV, Scarlett JM, Houpt KA. Long-tern risks and benefits of early-age gonadectomy in dogs. *J Am Vet Med Assoc.* 2004;224(3):380-387.
42. McNicholas WT, Wilkens BE, Blevins WE, et al. Spontaneous femoral capital physeal fractures in adult cats: 26 cases (1996-2001). *J Am Vet Med Assoc.* 2002;221(12):1731-1736.

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For additional safety information, see brief summary of prescribing information on previous page.

Reference: 1. Teng KT, McGreevy PD, Toribio JL, et al. Strong associations of nine-point body condition scoring with survival and lifespan in cats. J Feline Med Surg. 2018;20(12):1110-1118.

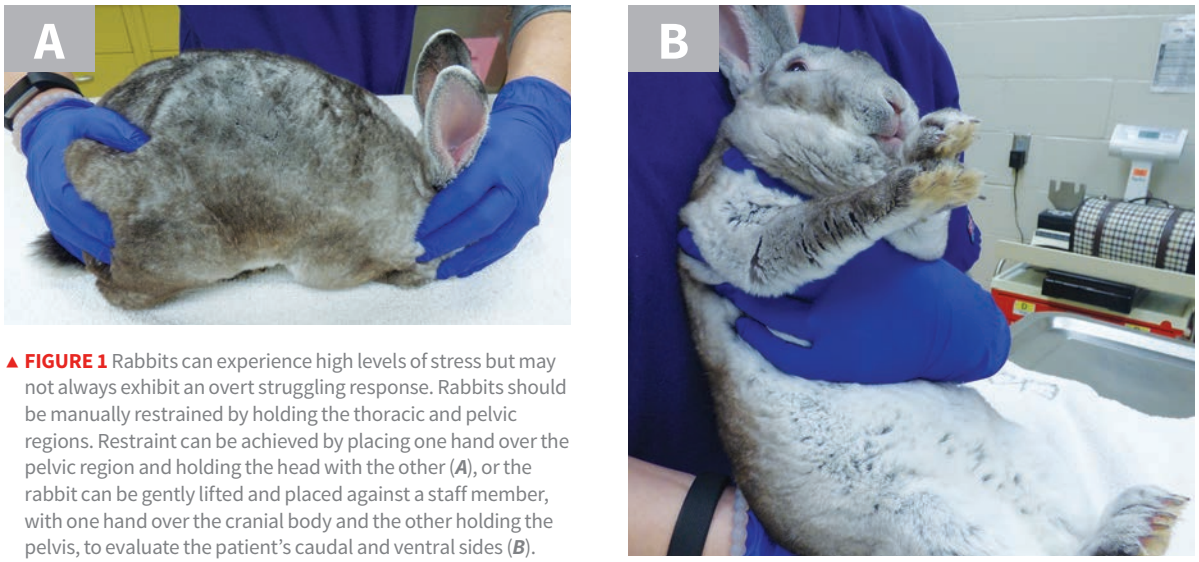
Small Mammal Restraint Techniques

David Eshar, DVM, DABVP (ECM), DECZM (SM & ZHM)
Kansas State University

Many exotic companion mammals have an inherent fight-or-flight response. Safe handling techniques can minimize stress and reduce the chance for trauma in these patients. Body size, sensitive skin, and, in some species, fragile, long bones should be considered.

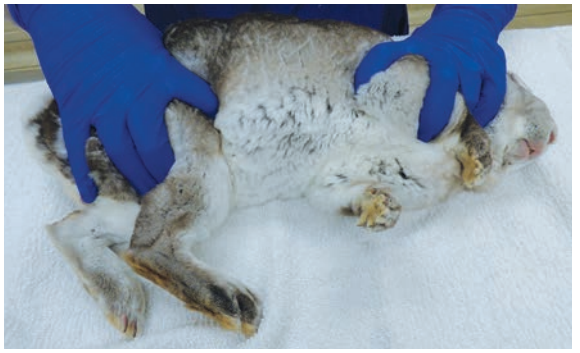
During examination, patients should be approached in a calm, gentle manner and minimal physical force should be applied. Staff should wear gloves, as some animals may carry zoonotic pathogens.[1-3] Chemical immobilization with injectable sedatives or inhalant anesthesia should be considered in patients that are extremely fractious and/or painful and for invasive and/or prolonged procedures.

The following can serve as a general guide for handling select small mammals commonly evaluated in the clinical setting.

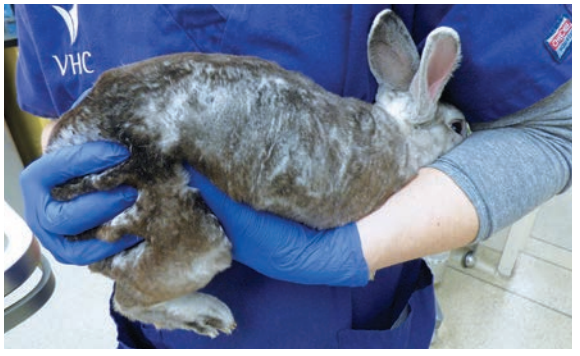


▲ **FIGURE 1** Rabbits can experience high levels of stress but may not always exhibit an overt struggling response. Rabbits should be manually restrained by holding the thoracic and pelvic regions. Restraint can be achieved by placing one hand over the pelvic region and holding the head with the other (***A***), or the rabbit can be gently lifted and placed against a staff member, with one hand over the cranial body and the other holding the pelvis, to evaluate the patient's caudal and ventral sides (***B***).

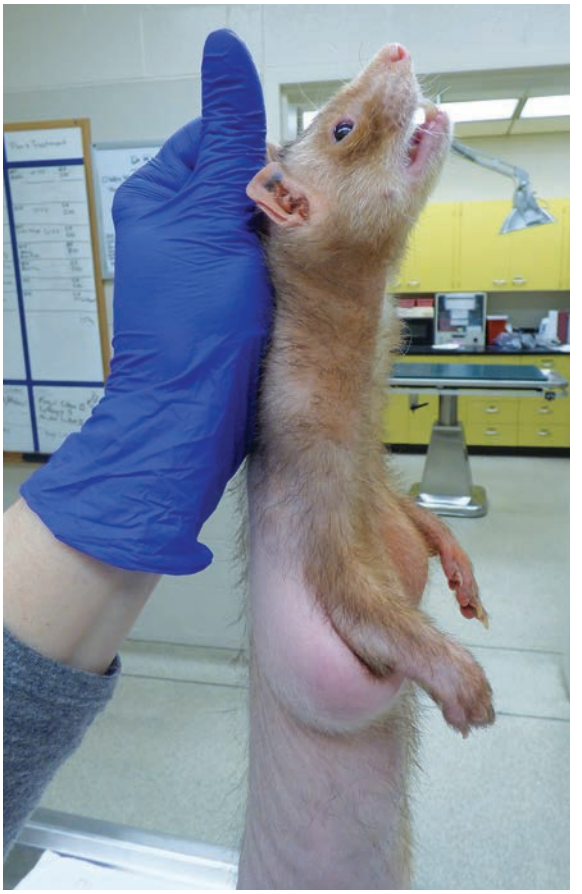
▲ **FIGURE 2** Rabbits can be enveloped with a towel for a less traumatic head and oral cavity examination. The patient's head should be exposed and secured with a staff member's fingers placed behind the rabbit's ears and under the mandibles to allow for oral, ocular, and otic examinations.



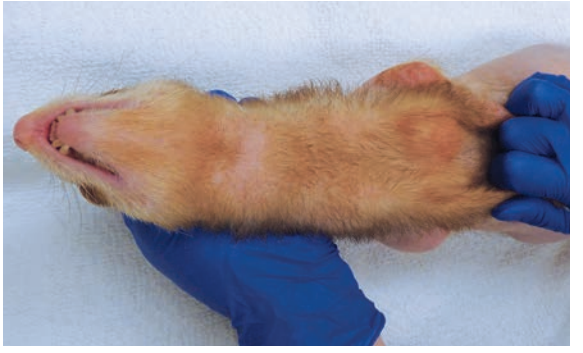
▲ **FIGURE 3** Gentle, lateral restraint can be helpful for lateral saphenous venipuncture in rabbits. One hand can hold the thorax while the other restrains the pelvis and holds the pelvic limb above the knee.



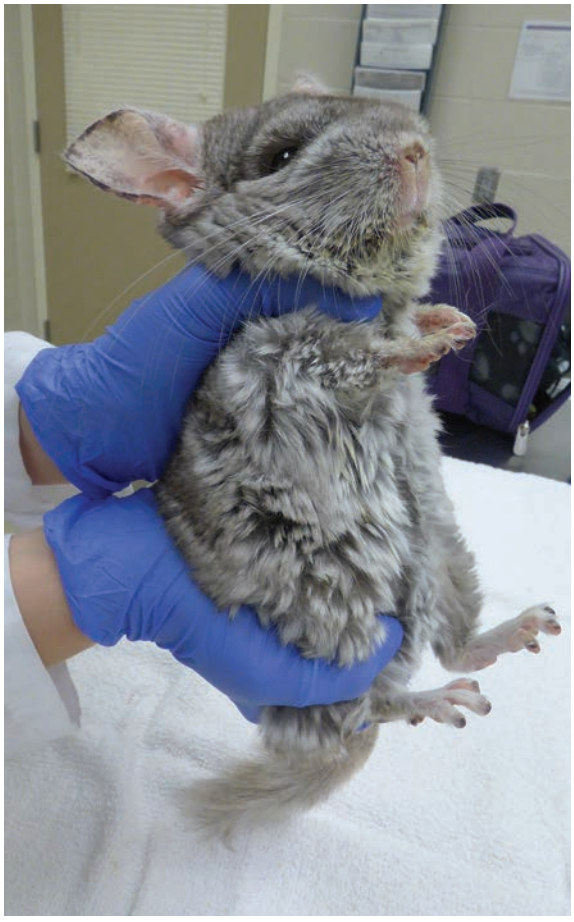
▲ **FIGURE 4** Rabbits that need to be briefly transported can be wrapped in a towel or held in a football carry position, in which the rabbit's head is tucked in the crook of a staff member's elbow, the body is supported underneath, and the pelvic end of the patient is controlled.



▲ **FIGURE 5** Many ferrets in North America are tame, and physical examination can be performed without manual restraint. A ferret can be briefly immobilized by firmly grasping the scruff with a full palm; the loose part of the dorsal thoracic region and the head are held and the entire body is suspended.

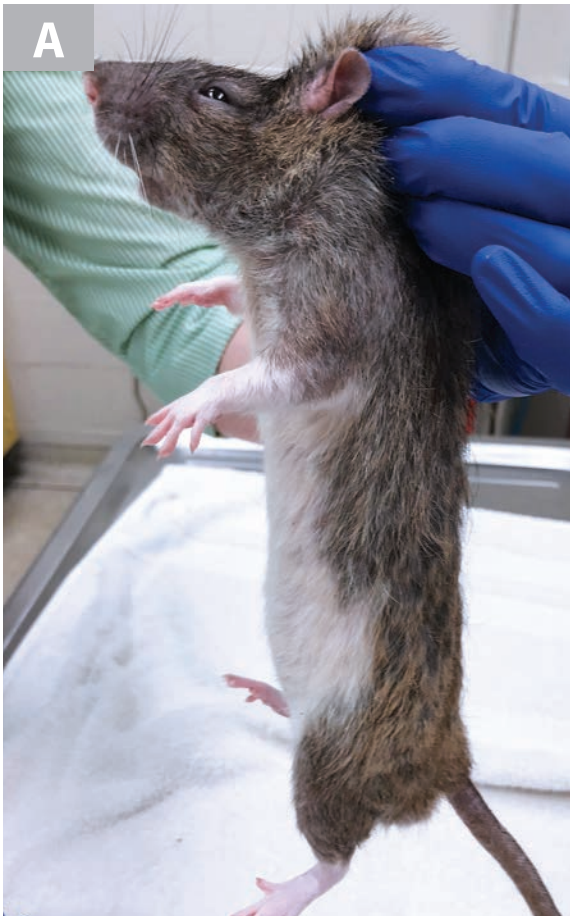


▲ **FIGURE 6** For venipuncture or other procedures, some ferrets may allow manual restraint to be performed by 2 staff members, with one grasping the scruff of the extended neck and pulling the thoracic limbs down and the other controlling the pelvic limbs. Sedation is often required for a thorough oral examination, venipuncture, and/or imaging.

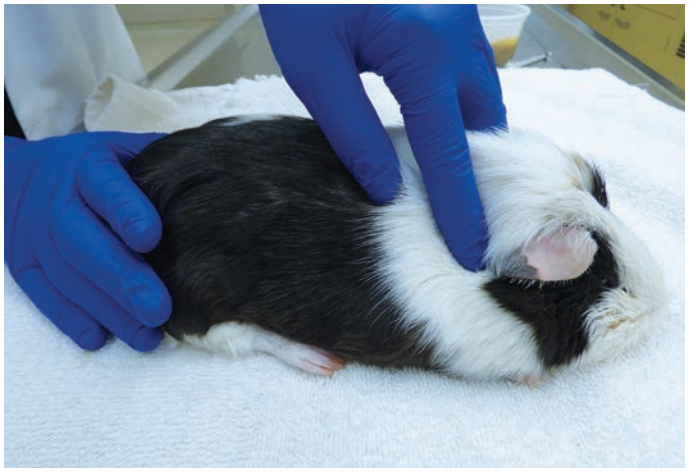


▲ **FIGURE 7** Many chinchillas will not struggle and can be handled gently during physical examination; however, some may jump, bite, vocalize, and/or spray urine. Trauma caused by handling (eg, fur slip, tail degloving, long-bone fractures) can be avoided by having a staff member restrain the patient with a full-palm grip with both hands over the dorsal thoracic and pelvic regions while avoiding fur and limb pulling during examination.

Some chinchillas may jump, bite, vocalize, and/or spray urine.



▲ **FIGURE 8** Myomorph rodents (eg, mice, rats, hamsters, gerbils) can be fractious and may inflict a painful bite in response to being handled. Some patients may allow gentle cupping, although grasping the scruff may be needed for others. These animals can be restrained by grasping the scruff of the dorsal thoracic region with a full palm (***A***). An alternative method is to use the index and middle fingers to grasp the animal's entire body along the sides of the head, with the thumb and remaining fingers placed under the axillae and the other hand holding the pelvic region and the tail (***B***).



▲ **FIGURE 9** Guinea pigs are typically docile and can easily be restrained by grasping the entire body with fingers placed around the neck and the other hand placed over the pelvic region to support the body. For oral or ocular examinations, the guinea pig can be restrained using a towel, similar to the technique used in rabbits (see ***Figure 2***, page 19).

▲ **FIGURE 10** Sugar gliders can be fractious and exhibit serious fight-or-flight responses when examined. These patients are good at escaping and have thin skin and fragile limbs. However, it is possible to manually restrain these patients for a limited physical examination. Because they have long, piercing incisors, a firm dorsal palm grip on their body, small towels, and thick protective gloves should be used. Inhalant anesthesia may be indicated, as manual restraint may not fully eliminate most associated risks.

See page 67 for references.

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Nonsteroidal Anti-Inflammatory Drug Toxicity

NSAID intoxications are common in small animal practice. NSAIDs are direct cyclooxygenase (COX) inhibitors; more modern NSAIDs selectively target the inducible COX_2 isoform, which is upregulated in inflammatory periods. NSAIDs are rapidly absorbed from the GI tract, with peak plasma concentrations achieved within 2 to 4 hours of administration; they are highly protein-bound, and most undergo enterohepatic recirculation and hepatic glucuronidation before being eliminated through urine.

COX-induced prostaglandin synthesis leads to mucus production and normal perfusion in the GI tract; thus, GI adverse effects predominate with NSAID intoxication. Effects are dose-dependent and can include vomiting, diarrhea, melena, hematemesis, and GI ulceration. Laboratory abnormalities can include regenerative anemia, hypoproteinemia, and elevated BUN:creatinine ratio. Renal injuries are of particular concern in patients receiving high NSAID doses or in volume-depleted patients in which prostaglandins help maintain renal blood flow and glomerular filtration. Renal pathologic changes can include papillary necrosis and interstitial nephritis. NSAID intoxication, particularly with aspirin, may result in platelet dysfunction due to impaired thromboxane production. Liver injury is generally uncommon and sometimes occurs idiosyncratically with normal NSAID doses; hepatic injury may be more pronounced in patients with pre-existing liver disease. Variable CNS signs (eg, depression, seizures, ataxia) may be seen with NSAID intoxication.

Treatment usually includes induction of emesis, administration of activated charcoal, and diuresis; gastroprotectants (eg, H_2-receptor antagonists, proton pump inhibitors) are often prescribed. Packed RBCs may be indicated in patients that have clinically relevant ulceration. More recent interventions have included lipid therapy, hemodialysis using a charcoal filter attached to the unit, and plasmapheresis. —*Lynch A*

GI Complications in Mechanically Ventilated Patients: What's the Evidence?

GI dysfunction in critically ill patients has been associated with worse outcomes, possibly due in part to interference with the provision of nutritional support. Associated negative effects of malnutrition can include respiratory muscle weakness, decreased wound healing, and impaired immune function. These effects can impact the ability to successfully wean a patient from a ventilator and can negatively impact patient morbidity and mortality.

In the limited studies evaluating enteral nutrition in mechanically ventilated veterinary patients, ≤60% of patients required interruption of nutritional support due to GI dysfunction (eg, regurgitation, aspiration). This interruption may result in adverse effects that result from a negative energy balance.

In human medicine, the term *acute GI injury* (AGI) has been proposed to describe GI dysfunction resulting from acute illness in critically ill patients. A grading scheme for AGI severity has also been introduced, with guidelines for management of these patients based on AGI grade (I-IV). Similar guidelines do not exist for veterinary patients; treatment cornerstones include hemodynamic stabilization to optimize splanchnic perfusion in mechanically ventilated patients, treatment of underlying disease, multimodal analgesia, early nutritional intervention, and interventional use of prokinetic drugs.—*Hoehne SN*

Probiotics & Their Use in Inflammatory Bowel Disease

Most of the understood and proposed mechanisms of action of probiotics are directly or indirectly related to the GI tract (ie, through competition or interaction with less beneficial luminal or adherent microorganisms, through effects on the mucosal immune system, or through effects on intestinal epithelial cells). However, few studies have demonstrated a health benefit of probiotics in small animals, and none have evaluated their use in critically ill patients.

Proposed benefits for ICU patients—human or animal—include maintenance of epithelial barrier function, nutritional support for epithelial cells, and inhibition of colonization with pathogenic bacteria. Critically ill humans undergo dysbiosis at several organ sites, leading to loss of microbial diversity with a tendency for pathogens to dominate. Probiotic use has been shown to cause significant reductions in infections following critical illness in humans; however, the probiotic species and doses used in studies have varied widely. Thus, recommendations cannot be made regarding dose and type, and inference of treatment recommendations for dogs and cats is difficult, as probiotic effects have been shown to be strain- and species-specific.

Diseases of dogs and cats that have shown improvement in some probiotic studies include infectious enteritis, stress-induced diarrhea, chronic constipation, and inflammatory bowel disease. Other studies, however, have shown no benefit in patients with similar conditions (eg, food-responsive enteropathy, feline herpesvirus 1, *Giardia* spp infection). Promising studies in humans have shown successful use of probiotics, symbiotics, and fecal microbiota transplantation in the prevention and treatment of diarrhea, sepsis, and *Clostridium difficile* colitis. Further studies are needed regarding the role of microbiome changes in critically ill humans and animals.—*Salavati S*

Inference of treatment recommendations for dogs and cats is difficult, as probiotic effects have been shown to be strain- and species-specific.

Extracorporeal Therapy: Beyond Hemodialysis & Apheresis

Examples of therapies offered in clinics using extracorporeal blood purification include intermittent hemodialysis, continuous renal replacement therapy, and apheresis. New advances in human medicine have led to the development of novel techniques that may help emergency and critical care clinicians.

For patients with hyperkalemia unresponsive to medical therapy, renal replacement therapy and hemodialysis have been used but require a technical platform, potentially large fluid volumes, and trained personnel.

Research studies in swine have shown that circulation of ultrafiltrate through cartridges containing potassium-adsorbing beads can control plasma potassium concentrations without the addition of replacement fluids. Although this potassium adsorption process requires circulating the blood in an extracorporeal circuit, it could be a more manageable circuit to use than those currently in use. Cartridges have also been developed to nonspecifically adsorb cytokines and chemokines in a concentration-dependent manner, which could have application in septic shock patients. These cartridges have also been used in cases of rhabdomyolysis to remove myoglobin, and their use shows promise for a wide range of diseases in human ICU patients.

With extracorporeal membrane oxygenation (ECMO), blood circulates through a membrane acting as an artificial lung, removing carbon dioxide and increasing oxygen. In human medicine, increased interest has been shown for ECMO use in ICU patients, emergency patients with concurrent compromised cardiovascular and/or pulmonary function, and in field situations; however, ECMO equipment is costly and a large, coordinated team is needed to implement this treatment.—*Hoareau GL*

Cannabinoids and Animal Health

An overview for veterinary professionals

We're dedicated to bringing clarity to CBD science.

This guide is designed to provide veterinary professionals with clear and unbiased information on the evolving science of cannabinoids—in particular, cannabidiol (CBD)—and their application in promoting and improving animal health.

In the following pages, we'll cover the science of cannabinoids, survey current evidence on their clinical efficacy and safety, and outline the emerging legal and regulatory environment.

It's a brave new world in pet health, and there's a lot to discover. **So read on.**

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Basics

Cannabis, cannabinoids, and the endocannabinoid system

What's the difference between cannabis and hemp?

Cannabis refers to the plant *Cannabis sativa,* which originated in Central Asia, and has been used medicinally for more than 5,000 years. There are thousands of varieties of the cannabis plant, which differ in their compounds (e.g., cannabinoids and terpenes). The proportion of compounds in the cannabis plant determines its pharmacological properties.

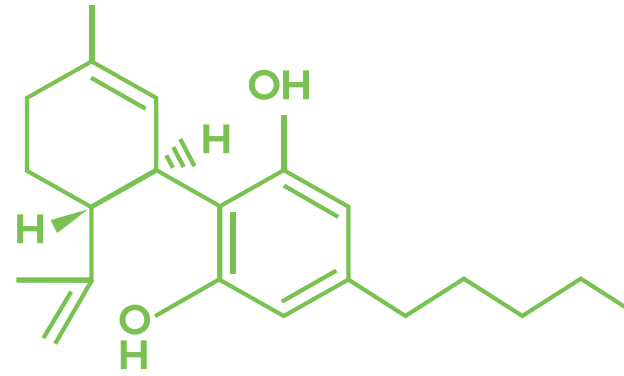
Hemp is a legal definition for varieties of the *Cannabis sativa* plant with low levels of Δ9-tetrahydrocannabinol (THC) (not more than 0.3% in the U.S. and not more than 0.2% in Europe).

> ***Canopy Animal Health's research is focused on developing safe and efficacious products using hemp-derived CBD.***

Key cannabinoids

Cannabinoids are molecules that interact with receptors in the body. They are divided into three categories:

- **Endocannabinoids,** which are naturally produced in the body and form part of the endocannabinoid system (ECS).
- **Phytocannabinoids,** which are plant-based compounds found in cannabis, as well as other plants. While CBD and THC are the best known, scientists have identified more than 120 phytocannabinoids.
- **Synthetic cannabinoids,** which are compounds artificially synthesized to mimic the structure and/or function of endocannabinoids or phytocannabinoids.



CBD

First identified in 1940, CBD is one of more than 120 phytocannabinoids scientists have identified. It appears in significant concentrations in the hemp plant. Unlike THC, CBD is not considered intoxicating; and because it functions indirectly, and through different receptors than THC, it may have potential favorable effects on anxiety, inflammation, and epilepsy, again without intoxicating side effects.

The ECS

This is a ubiquitous lipid-signaling system found in humans and other animals, including dogs and cats.

The ECS consists of three main components:

- Cannabinoid 1 and 2 receptors (CB1 and CB2), which are found in various organ systems throughout the body.
- Endocannabinoids, such as N-arachidonoylethanolamine (anandamide, AEA) and 2-arachidonoylglycerol (2-AG), which interact with CB1 and CB2, as well as other receptor families.
- Enzymes, including fatty acid amide hydrolase (FAAH), involved in endocannabinoid synthesis and degradation.

The ECS has been implicated in various physiological processes, including relaxation, eating, and sleeping, as well as memory and neuroprotection.

The dysregulation of the ECS has been implicated in pathophysiological processes.

Using CBD in Veterinary Practice

What is the regulatory status of CBD in the United States?

Aside from *Epidiolex*®[1], products containing CBD that claim to treat, mitigate, prevent, or cure disease—effects reserved for drugs—have not been approved by the U.S. Food and Drug Administration (FDA) and cannot be lawfully marketed.

Likewise, foods or dietary supplements that include CBD and are intended for human or animal consumption are also not permissible for sale in the U.S. However, given the growing public interest in CBD, the FDA is exploring potential regulatory pathways for conventional foods and dietary supplements containing CBD to be lawfully marketed.

And while there are hemp products that can lawfully be put into human foods, such as hulled hemp seeds, hemp seed protein, and hemp seed oil, these ingredients have not yet been approved for animal food.

Data on CBD safety and efficacy in animals

At this time, under federal law, there are no approved uses of CBD for animals. Nevertheless, research is being conducted on the safety and efficacy of CBD in companion animals, mainly dogs.

- A 2018 study at Colorado State University assessed the safety and pharmacokinetics of CBD (5 or 10 mg/kg twice daily for 6 weeks) in 30 healthy dogs when delivered orally in capsules (microencapsulated oil beads) or as an oil, or in transdermal form as a cream.[2, 3] The CBD-infused oil provided the most favorable pharmacokinetic profile. Overall, orally consumed CBD was well tolerated.
- A 2019 study at Colorado State University conducted in nine client-owned dogs with epilepsy showed that CBD (2.5 mg/kg twice daily for 12 weeks) in addition to existing antiepileptic treatments caused no adverse behavioural effects and had favorable effects on the frequency of seizures.[4]
- A 2018 study at Cornell University demonstrated favorable effects of CBD (2 mg/kg twice daily for 4 weeks) on pain and activity associated with osteoarthritis in sixteen client-owned dogs. The dogs were perceived to be more comfortable and active and no side effects were reported by owners.[5]

Based on the existing studies, dogs appear to tolerate oral CBD well. A clinically significant finding reported across these studies was elevated blood levels of alkaline phosphatase (ALP), a liver enzyme, which should be monitored with CBD intake.

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[1] Registered trademark of GW Pharmaceuticals

[2] Bartner LR, McGrath S, Rao S, Hyatt LK, Wittenburg LA. (2018). Pharmacokinetics of cannabidiol administered by 3 delivery methods at 2 different dosages to healthy dogs. Canadian Journal of Veterinary Research;82:178-183.

[3] McGrath S, Bartner LR, Rao S, Kogan LR, Hellyer PW. (2018). A Report of Adverse Effects Associated with the Administration of Cannabidiol in Healthy Dogs. Journal of the American Holistic Veterinary Medical Association;52:34-38.

[4] McGrath S, Bartner LR, Rao S, Packer RA, Gustafson DL. (2019). Randomized blinded controlled clinical trial to assess the effect of oral cannabidiol administration in addition to conventional antiepileptic treatment on seizure frequency in dogs with intractable idiopathic epilepsy. Journal of the American Veterinary Medical Association;254:1301-1308.

[5] Gamble L-J, Boesch JM, Frye CW, Schwark WS, Mann S, Wolfe L, et al. (2018). Pharmacokinetics, Safety, and Clinical Efficacy of Cannabidiol Treatment in Osteoarthritic Dogs. Frontiers in Veterinary Science; 5:165.

Discussing CBD with clients

Most U.S. veterinary medical licensing and pharmacy boards are advising veterinarians to avoid discussing, recommending and selling products containing CBD until further guidance is provided by the FDA.

The Animal Medicinal Drug Use Clarification Act of 1994 (AMDUCA) permits veterinarians to prescribe extralabel uses (i.e., uses not in accordance with approved labelling) of approved human drugs for animals under certain conditions. Among other limitations, extralabel use of a drug requires the lawful order of a licensed veterinarian in the context of a valid veterinarian-client-patient relationship, and only in circumstances when the health of an animal is threatened or suffering, or death may result from failure to treat.

~29% of U.S. veterinarians are asked about CBD products weekly.[6]

Should a client initiate a conversation about cannabinoids or CBD, below are some key takeaways you may want to communicate to them.

- CBD is a cannabinoid found in cannabis plants.
- Hemp is a cannabis plant variety that contains low levels of THC.
- CBD does not produce the "high" that THC does.
- Hemp seeds and hemp seed oil do not contain CBD.
- The FDA has not approved CBD for for use in pet food or animal feed.
- Studies conducted to date suggest that dogs tolerate CBD well.
- Cannabis, CBD, or THC products intended for human use should not be provided to pets. These products could contain other ingredients that may be harmful to pets.

The regulatory landscape for CBD is evolving. Up-to-date information on the regulation of CBD in the U.S. is made available by the FDA. We also recommend you contact your local veterinary board to understand your state's cannabis regulations.

---

[6] Kogan L, Schoenfeld-Tacher, R, Hellyer, P, Rishniw M (2019). US Veterinarians' Knowledge, Experience, and Perception Regarding the Use of Cannabidiol for Canine Medical Conditions. Frontiers in Veterinary Science; 5:338.

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Imaging GI Disease

Abdominal radiography, ultrasonography, and CT all have a place in the diagnosis of GI disease, but the chosen technique(s) varies depending on the underlying disease. Radiography is typically sufficient in cases of gastric dilatation-volvulus or of radiodense foreign body. However, in many cases, GI foreign bodies may not be identified on radiographs and ultrasonography may be useful. Some foreign bodies (eg, swallowed bones) have a hyperreflective interface and a strong acoustic shadow; others behave more like soft tissue and have a minimal acoustic shadow.

Ultrasonography can distinguish between mechanical and functional ileus and between intraluminal obstruction and mural masses. Partial intestinal obstruction, recent obstruction, and duodenal obstruction are often not distinguishable radiographically, in which case abdominal ultrasonography or CT is necessary. Linear foreign bodies and intestinal intussusception are readily identifiable via ultrasonography. Ultrasonography is also often used to differentiate between gastroenteritis, pancreatitis, and mechanical obstruction.

Ultrasonography has its disadvantages, though. For example, the stomach in deep-chested dogs can be difficult to image with this modality. In addition, one study has suggested that ultrasonography is better indicated in older patients, patients with a greater number of vomiting episodes and weight loss, and patients suspected of having neoplastic disease. Ultrasonography and CT can be useful for evaluating nonperforated GI ulceration; radiography, however, will only detect pneumoperitoneum in cases of GI ulceration or abdominal fluid in cases of peritonitis. Ultrasonography can be useful for detecting and sampling focal accumulations of peritoneal fluid, which aids in early diagnosis of septic peritonitis subsequent to GI ulceration.—*Benigni L*

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WSAVA DENTAL SERIES PAGE 61

M. A. SALISBURY, DVM, DACVO, is a veterinary ophthalmologist at Animal Eye Care in Sarasota, Florida. She earned her DVM from Cummings School of Veterinary Medicine at Tufts University and completed an internship in small animal medicine and surgery and a residency in ophthalmology at University of Georgia.

CONSULT THE EXPERTS PAGE 26

MARGARET SWALEC, MS, is a retired educator. She earned her BS in special education from Illinois State University and her MS in special education from St. Xavier University. Before retirement, she served as the special education department supervisor at Libertyville High School in Illinois.

CONSULT THE EXPERTS PAGE 26

KAREN M. TOBIAS, DVM, MS, DACVS, is a professor of small animal soft tissue surgery and a board-certified surgeon at University of Tennessee. She earned her DVM from University of Illinois, completed an internship at Purdue University, and completed a residency at The Ohio State University, where she also earned her MS. Dr. Tobias has published more than 120 scientific articles and book chapters and is the author of *Manual of Small Animal Soft Tissue Surgery*, coeditor of *Veterinary Surgery: Small Animal*, and coauthor of *Atlas of Ear Diseases of the Dog and Cat*.

CONSULT THE EXPERTS PAGE 26

TOP 10 PAGE 10

CONSULT THE EXPERTS

IMPROVING OWNER COMPLIANCE WITH PET MEDICATION REGIMENS

Karen M. Tobias, DVM, MS, DACVS
University of Tennessee

M. A. Salisbury, DVM, DACVO
Karen McClung
Animal Eye Care
Sarasota, Florida

Margaret Swalec, MS

Successful treatment of medical conditions in veterinary patients typically requires pet owner adherence to and compliance with prescribed therapeutic regimens. Owner adherence is described as when the owner obtains the prescribed medications and initiates and continues administration as prescribed.[1] Compliance is the consistency and accuracy with which the owner follows the prescribed regimen, including dose, frequency, duration, and timing of administration.[1]

Consequences of Lack of Adherence & Compliance

In human medicine, the average rate of patient adherence is ≈50%.[2] In veterinary medicine, study results indicate that compliance and adherence are similarly low; in studies of dogs receiving short-term antimicrobial therapy, 56% to 59% of owners administered the incorrect number of doses per day, with most underdosing their pet.[3,4] Adherence failure and lack of compliance can result in lack of patient improvement, disease progression, or even death of the patient. Lack of compliance can also have more subtle adverse effects; for example, incomplete treatment of infection can promote antimicrobial resistance.[3] Withdrawal signs can occur with abrupt discontinuation of some drugs, and overdosing can result in toxicity or extra costs. Decisions regarding treatment efficacy can be adversely influenced by unidentified poor compliance, and lack of improvement can increase the frustration of the pet owner and/or veterinary staff.[1,3]

Factors that Affect Adherence & Compliance

Factors that affect adherence to and compliance with therapeutic regimens include cost and accessibility of medications, number of drugs administered, frequency and duration of drug administration, complexity of the treatment regimen, and abilities of those administering the drug (eg, able to administer eye drops to pets, able to administer oral medications to cats).[2,3,5,6] Patient behavior and owner lifestyle (eg, long working hours or travel) can also preclude drug administration that is required more than once a day.

In studies of dogs receiving short-term antimicrobial therapy, 56% to 59% of owners administered the incorrect number of doses per day, with most underdosing their pet.[3,4]

Some therapeutic regimens are inherently complex. For example, a 5-minute interval between eye drops is typically advised to prevent washout of the previous medication and, in some cases, to increase the combined effects of the drugs.[7] A longer interval may be necessary between oral administration of some drugs (eg, oral sucralfate suspension administration is delayed for 2 hours after doxycycline administration) to decrease negative effects on bioavailability.[8] Such necessary but complex instructions are likely to reduce pet owner compliance.

Improving Compliance

Simplifying dose regimens can help improve owner compliance.[9] In a study of canine otitis externa, owner compliance with the therapeutic regimen increased from 21% to 79% when the topical medication was only administered once a day rather than twice a day and as a single volume rather than as multiple drops.[10] Similar findings were noted in another study when antibiotics were prescribed for once- or twice-daily administration rather than every 8 hours.[9]

Clinicians can also improve pet owner compliance with complex therapeutic regimens by building a relationship with the owner, eliciting the owner's perspective on treatment, demonstrating empathy, and investing the owner in the outcome by sharing information regarding the condition and treatment options and involving the owner in the decision-making process.[1] Follow-up telephone calls and coaching from staff can also be helpful.[11] Some owners may be hesitant to discuss technical difficulties with clinicians; however, if staff provide demonstrations and observe treatments, owners may be more confident in the treatment plan and therefore more compliant.[1,2,5,12]

Compliance can be verified by examining the amount of medication that remains during a

follow-up visit.[2,13] If residual medication counts are unexpectedly high or low, the staff should determine the cause and ways to assist the owner in improving compliance.

Tools for improving compliance include written instructions, videos, charts, checklists, calendars, and special packaging that explain, organize, and streamline treatments.[1,2,5,12]

Compartment Organizers

In human medicine, division of daily or weekly doses into a multicompartment pill box can help increase patient compliance.[2] However, such a technique is usually not possible with topical or oral liquid medications. In addition, removing medications from labeled containers may be risky if the medications appear similar, as in the case of omeprazole and cyclophosphamide capsules, acepromazine and chlorpheniramine tablets, and grapiprant and metronidazole caplets.

A safer method may be the use of a compartmentalized tray that can be labeled with times and medications (eg, name, color, number) and hold the medication containers (***Figure 1***). The owner can place the medications in a row at the beginning of the day and move each drug to the next row once administered; this allows the person administering a complex medication regimen to keep track of the drugs that have been administered. Additional labels can be added to indicate which medications should be stored in the refrigerator.

Checklists

Examples of medication logs are available (see ***Suggested Reading***, page 32). Clinicians and staff may be able to devise medication sheets that are more readily adaptable to the patient or type of treatment (***Figures 2***, next page, and ***3***, page 31).

Checklists should be adjusted for each patient. Rows can be added for headings or special instructions (eg, rest periods between treatments); these headings can later be filled in with treatment times once the best scheduling options have been discussed with the owner. Medications should be entered on the checklist in the order of administration, and rows should be left empty as needed for additional instructions between treatments. Maintaining a document of pretyped instructions with blank spaces to add the dose, frequency, or other medication directions can be beneficial. The details of each medication should be entered after each instruction is added to the checklist to tailor the treatment to the patient. Including a box for additional instructions or information (eg, next appointment time or clinician signature line) at the bottom of the document can also be helpful. To improve visual recognition, color-coding each treatment and placing a sticker of similar color on the checklist may help the owner adhere to the schedule.

The medication checklist can be copied and printed for daily use; as a more environmentally sound practice, the checklist can be laminated or placed in a clear plastic document folder. The owner can use an erasable marker to check off each medication once administered.

Continues ▶

▲ **FIGURE 1** For complex medication regimens, a compartmentalized tray can be labeled with administration times and other information. In addition, medications and compartments can be color-coded to provide visual cues. In this example, each medication has its own column and each row represents a different treatment time. The owner moves the medication to the next labeled compartment in the column after it is administered and moves the medications back to the top row after the final dose of the day.

FIGURE 2

DATE: _____ PATIENT NAME: _____

AGE: _____ SEX: _____ BREED: _____ WEIGHT: _____

Right Eye	Prescription	Left Eye
Treatment Time		**Treatment Time**
□ □ □ □		□ □ □ □
□ □ □ □	1. Eye wash • Rinse both eyes of mucus ≥2 times per day. • Use a water-soaked cotton ball to wipe debris from eyelids. • Use separate cotton for each eye and discard.	□ □
	Wait 1 to 2 minutes	
□ □ □ □	2. Betadine solution (1:5 dilution) • Mix 5 mL of water with 0.1 mL of betadine. • Using a saturated cotton ball, instill a few drops in the right eye. • Cleanse lids 2 times per day. • Mix fresh solution for each administration. Solution can stain.	
	Wait 5 to 10 minutes	
□ □ □ □	3. Tobramycin 0.3% ophthalmologic solution (antibiotic) • Instill 1 drop in right eye 4 times per day.	
	Wait 5 to 10 minutes	
□ □ □ □	4. Autologous serum • Keep refrigerated. • Instill 1 drop in the right eye 4 times per day. • Discard after 5 days. • Refill as needed.	
	Wait 5 to 10 minutes	
□ □ □ □	5. Ofloxacin 0.3% ophthalmologic solution (antibiotic) • Instill 1 drop in right eye 4 times per day.	
○ ○	6. Doxycycline (100-mg chews) • Give chew orally 2 times per day with plenty of water. • Do not give with cheese or calcium-containing products.	

Follow chart carefully. Wait between medication administrations as indicated. Keep Elizabethan collar on at all times. Offer food and water, and monitor eating. Use a soft, water-moistened paper towel to wipe the inside of the Elizabethan collar as needed to keep clean of food and drool. If you think the eye(s) is getting worse or observe any change (eg, more painful, more discharge, squinting, restless, loss of appetite), contact your veterinarian immediately.

Please bring all medications and checklists to your next appointment. NEXT APPOINTMENT: _____

▲ **FIGURE 2** For complicated medication regimens, a well-designed daily medication log can help improve owner compliance. In this example, each column represents a different administration time and each row a different treatment. Administration times are filled in at the top by the clinician or staff using times tailored to the patient's condition and the owner's lifestyle. Different checkbox shapes can be used to help owners distinguish different administration methods; in this example, squares represent eye drops and circles represent oral tablets. Owners can copy the instructions to make daily checklists, or the instructions can be sealed in plastic so that an erasable marker can be used to check off treatments.

Additional Safety Measures

If a medication must be refrigerated between each administration, medication management options should be discussed with the owner. Some owners may prefer to leave an empty container in the appropriate compartment as a reminder, whereas others may wish to retrieve the medication from the refrigerator immediately before administration and place it in the appropriate compartment. If several medications must be refrigerated, incorporating a separate compartmentalized organizer that fits on a refrigerator shelf may be helpful.

Conclusion

Successful resolution of some veterinary conditions may rely on complex treatment regimens. Owner compliance with these regimens can be improved by simplifying the dose schedule and providing clear, concise written instructions, charts, or checklists. Use of compartmentalized, labeled medication trays or color-coded medication containers and instructions can provide additional visual cues to help the owner deliver the treatments appropriately.

See next page for references.

FIGURE 3

DATE: _____ WEIGHT: _____

PATIENT: _____ OWNER: _____

Medication	Strength	Route	Frequency	7 AM	12 PM	6 PM	10 PM
Eye-irrigating solution		Both eyes	2 times per day				
Betadine (wait 1-2 minutes before administering next medication)	1:5 dilution	Right eye	2 times per day				
Tobramycin (wait 5-10 minutes before administering next medication)	0.3%	Right eye	4 times per day				
Autologous serum (wait 5-10 minutes before administering next medication)		Right eye	4 times per day				
Ofloxacin	0.3%	Right eye	4 times per day				
Doxycycline	100 mg	Oral	2 times per day				

2 times per day 4 times per day

▲ **FIGURE 3** Medication sheet in a tabular format. Shaded boxes indicate the medication was administered at that time.

References

1. Abood SK. Increasing adherence in practice: making your clients partners in care. *Vet Clin North Am Small Anim Pract.* 2007;37(1):151-164.
2. Jimmy B, Jose J. Patient medication adherence: measures in daily practice. *Oman Med J.* 2011;26(3):155-159.
3. Barter LS, Watson ADJ, Maddison JE. Owner compliance with short term antimicrobial medication in dogs. *Aust Vet J.* 1996;74(4):277-280.
4. Grave K, Tanem J. Compliance with short-term oral antibacterial drug treatment in dogs. *J Small Anim Pract.* 1999;40(4):158-162.
5. Gupta VS, Sethi H, Naik M. Strategies to improve glaucoma compliance based on cross-sectional response-based data in a tertiary healthcare center: the Glauco-Jung study. *J Curr Glaucoma Pract.* 2015;9(2):38-46.
6. Pantuzza LL, Ceccato MDGB, Silveira MR, Junqueira LMR, Reis AMM. Assocation between medication regimen complexity and pharmacotherapy adherence: a systematic review. *Eur J Clin Pharmacol.* 2017;73(11):1475-1489.
7. Denion E, Charlot F, Béraud G. A 5-minute interval between two dilating eye drops increases their effect. *Opt Vision Sci.* 2017;94(8):838-844.
8. KuKanich K, KuKanich B. Effect of sucralfate tablets vs. suspension on oral doxycycline absorption in dogs. *J Vet Pharmacol Ther.* 2015;38(2):169-173.
9. Adams VJ, Campbell JR, Waldner CL, Dowling PM, Shmon CL. Evaluation of client compliance with short-term administration of antimicrobials to dogs. *J Am Vet Med Assoc.* 2005;226(4):567-574.
10. Boda C, Liége P, Réme CA. Evaluation of owner compliance with topical treatment of acute otitis externa in dogs: a comparative study of two auricular formulas. *Intern J Appl Res Vet Med.* 2011;9(2):157-165.
11. Schneider SM, Hess K, Gosselin T. Interventions to promote adherence with oral agents. *Semin Oncol Nurs.* 2011;27(2):133-141.
12. McVeigh KA, Vakros G. The eye drop chart: a pilot study for improving administration of and compliance with topical treatments in glaucoma patients. *Clin Ophthalmol.* 2015;9:813-819.
13. Barter LS, Maddison JE, Watson ADJ. Comparison of methods to assess dog owners' therapeutic compliance. *Aust Vet J.* 1996;74(6):443-446.

Suggested Reading

The New York City Department of Health and Mental Hygiene. My medication log – keep it handy. The Graduate Center, City University of New York. https://www.gc.cuny.edu/CUNY_GC/media/CUNY-Graduate-Center/PDF/Health/My-Medication-Log.pdf. Accessed January 7, 2020.

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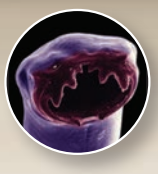
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See page 32 for product information summary.

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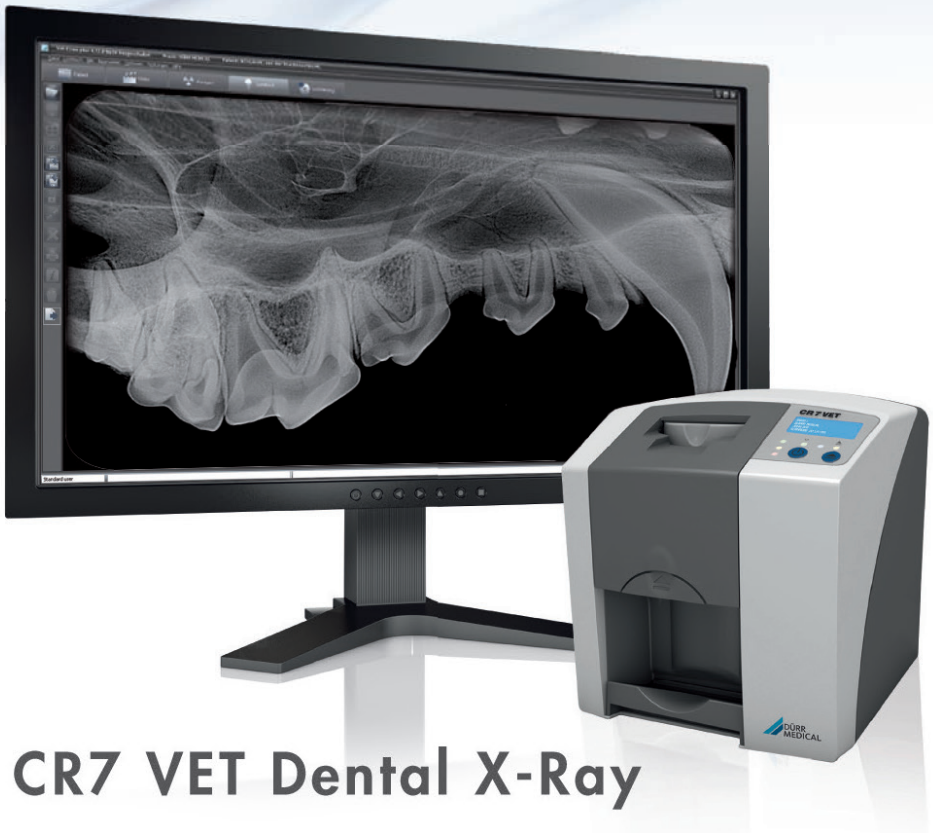

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Hypercalcemia

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

FOR MORE
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- Basophilia
- Decreased Total Thyroxine
- Eosinophilia
- Epistaxis
- Hypercholesterolemia
- Hyperkalemia
- Hypoalbuminemia
- Hypocholesterolemia
- Hypoglycemia
- Hypokalemia
- Hypophosphatemia
- Increased & Decreased Blood Urea Nitrogen
- Increased & Decreased Creatinine
- Increased Total Thyroxine
- Neutropenia
- Panting
- Regurgitation
- Tremors

See page 71 for references.

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

Following are differential diagnoses for patients presented with hypercalcemia.*

- Artifactual hypercalcemia
  - Severe lipemia or icterus
- Physiologic hypercalcemia (mild hypercalcemia due to bone growth in young animals)
- Increased protein binding
  - Hemoconcentration (ie, hyperalbuminemia)
  - Hyperproteinemia (ie, paraproteinemia)
- Malignant hypercalcemia (most common cause in dogs)
  - Lymphoma
  - Anal sac apocrine gland adenocarcinoma
  - Other carcinomas (eg, mammary, thyroid, lung, clitoral), particularly if metastatic to bone
  - Thymoma
  - Multiple myeloma
  - Osteosarcoma or other primary bone tumor
  - Melanoma
- Hypoadrenocorticism
- Idiopathic hypercalcemia (most common cause in cats)
- Primary hyperparathyroidism
- Chronic kidney disease (less commonly, acute kidney injury)
- Raisin/grape toxicity
- Hypervitaminosis D
  - Cholecalciferol toxicity
  - Calcipotriene/calcipotriol (eg, antipsoriasis creams) ingestion
  - Calcitriol or vitamin D overdose (eg, due to inappropriate dietary supplementation)
  - Plant (eg, day-blooming jessamine) ingestion
- Drug-induced effect
  - Thiazide diuretics
  - Excessive calcium (eg, calcium carbonate) supplementation
  - Aluminum-based phosphate binders
  - Dimethyl sulfoxide when used extra-label in the treatment of calcinosis cutis
- Localized osteolysis
- Osteomyelitis
- Hypertrophic osteodystrophy
- Disuse osteoporosis
- Granulomatous disease
  - Blastomycosis
  - Histoplasmosis
  - Hepatozoonosis
  - Schistosomiasis
  - Pythiosis
  - *Angiostrongylus vasorum* infection
  - *Heterobilharzia americana* infection
  - Secondary to biologic implants
- Benign humoral hypercalcemia
  - Benign mixed mammary tumors
  - Benign renal angiomyxoma
  - Benign esophageal/vaginal leiomyoma
- Hypervitaminosis A
- Retained fetus (dogs)

*Differential diagnoses for hypercalcemia do not have a determined order of likelihood and are listed in no particular order.

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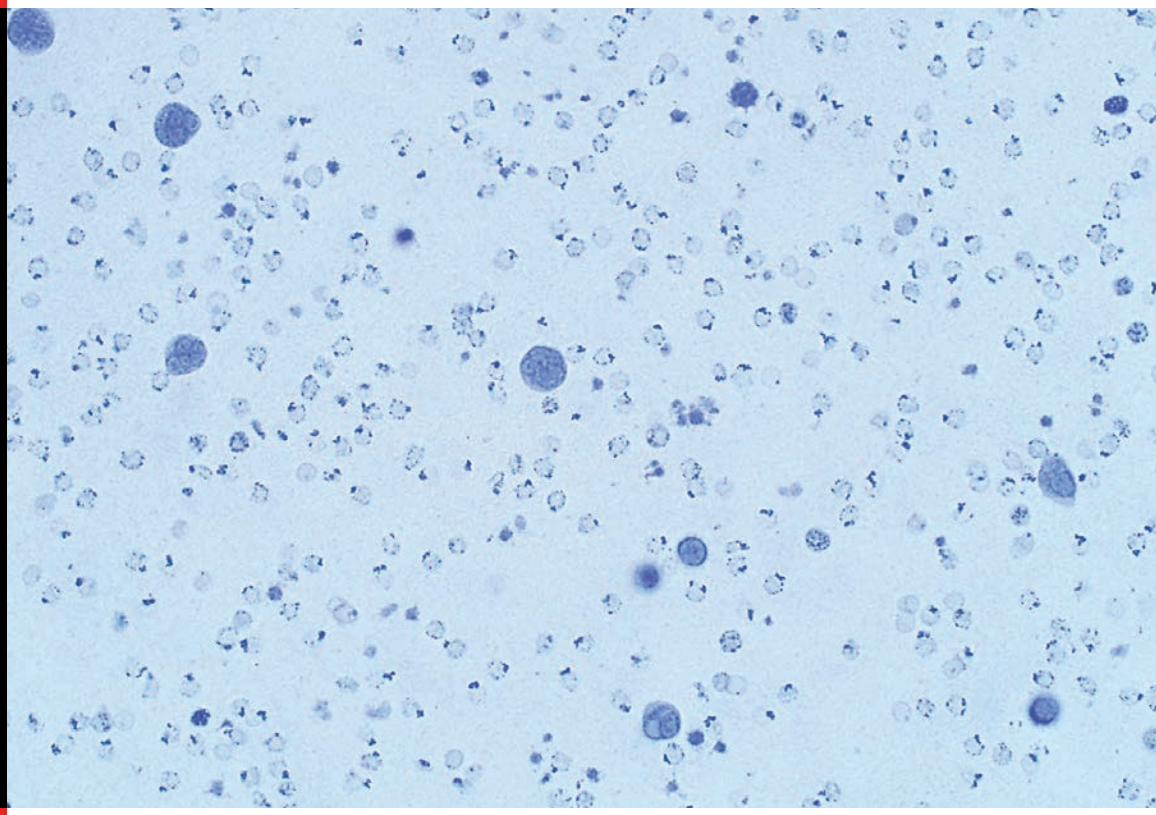
FROM PAGE TO PATIENT

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



Ultrasonography of the Feline Parathyroid Glands

Anthony Pease, DVM, MS, DACVR
WVC
Las Vegas, Nevada

In the Literature

Woods SJ, Palm C, Sheley M, Feldman EC, Pollard RE. Ultrasonography does not consistently detect parathyroid glands in healthy cats. *Vet Radiol Ultrasound*. 2018;59(6):737-743.

FROM THE PAGE ...

Ultrasonography is a valuable, noninvasive tool for evaluating the parathyroid gland in dogs, but very little information on the evaluation of parathyroid glands in cats is available. This study sought to ultrasonographically characterize the size, location, and appearance of parathyroid glands in cat cadavers and compared the results with histologic findings. The study also sought to ultrasonographically assess the thyroid lobes in living healthy cats that did not have clinically detectable kidney, parathyroid, or thyroid disease. The authors hypothesized that ultrasonography would detect 2 parathyroid glands in each thyroid lobe (ie, 4 total), with the glands appearing as hypoechoic nodules associated with the thyroid lobes. In addition, the authors hypothesized that a reference range for parathyroid gland size would be determined for healthy normocalcemic cats.

In the 6 cat cadavers, ultrasonography revealed 28 hypoechoic nodules in 12 thyroid lobes. On histology, 33 separate nodules were observed in the 12 thyroid lobes; 25 of these were characterized as parathyroid tissue and the remaining were characterized as being of thyroid origin. Of the 28 nodules identified on ultrasonography, only 6 could be confidently associated with nodules seen on histology.

In the 20 living healthy cats, thyroid glands were identified via ultrasonography in all cats, with only the right thyroid lobe not being evaluated in one cat due to poor compliance. This study demonstrated obtaining parathyroid gland measurements in nonsedated cats to be difficult, as generally only one measurement could be reliably obtained in each cat. Hypoechoic nodules frequently did not correspond to parathyroid tissue on ultrasonography, proving ultrasonography was not a reliable method for evaluating parathyroid tissue in healthy cats; this is important to note, as any hypoechoic nodule in thyroid glands is generally considered to be parathyroid tissue. Because ultrasonography could not differentiate normal parathyroid glands from thyroid tissue, no reference ranges were provided.

Although this study demonstrated normal parathyroid tissue to be ultrasonographically similar to thyroid tissue, evaluating the ultrasonographic appearance of the parathyroid glands in cats with suspected parathyroid disease and validating thyroid gland size in cats with known hyperthyroidism is necessary to determine the clinical applicability of ultrasonography when evaluating the thyroid and parathyroid glands in cats.

... TO YOUR PATIENTS

Key pearls to put into practice:

1. Obtaining parathyroid gland measurements in clinically normal cats through ultrasonography can be difficult without sedation.
2. Although this study found no benefit in performing ultrasonography to evaluate the parathyroid glands in normal cats, performing ultrasonography on parathyroid glands in cats with hypercalcemia may be beneficial.
3. Further studies on hypercalcemic cats may find that abnormal parathyroid tissue is easier to differentiate from thyroid tissue, but in normal cats, the parathyroid glands are not reliably visible.

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Jarod M. Hanson, DVM, PhD, DACVPM
United States Army
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In the Literature

Weese JS, Anderson MEC, Berhane Y, et al. Emergence and containment of canine influenza virus A(H3N2), Ontario, Canada, 2017-2018. *Emerg Infect Dis*. 2019;25(10):1810-1816.

FROM THE PAGE ...

Multiple outbreaks of canine influenza virus (CIV) caused by avian-origin H3N2 influenza A virus have been reported in the United States since 2015 and in Canada since 2017. This virus was a new introduction to North America, and these outbreaks were due to multiple virus introductions associated with the importation of rescue dogs from Asia.[1]

This study illustrated several important points in the Canadian outbreak, most notably the use of contact tracing and longitudinal sampling. Use of contact tracing effectively identified other at-risk dogs for testing, whereby the actual nidus of infection for several of the outbreaks was identified. Contact tracing confirmed previously identified risk factors for CIV, including exposure to rescue dogs from Asia, use of boarding and grooming facilities, and, in one case, use of a public trail. In addition, longitudinal sampling confirmed the efficacy of a 28-day quarantine period, especially when combined with 2 sequential negative PCR tests, a requirement for releasing animals from quarantine.

Overall mortality observed in the H3N2 CIV cases in this study was 2%, which is similar to previous observations.[2] The 2 fatalities that occurred were in older dogs; this observation reinforces the need to vaccinate and revaccinate older dogs, particularly when other risk factors are present (eg, boarding, grooming). The need for initial vaccination to be administered twice, 14 to 28 days apart, limits the overall utility of vaccination during an outbreak, supporting the need for proactive vaccination.

In addition, although virus survival times tend to be longer in colder temperatures, the spread of CIV in this study appears to have been limited. This was presumed to be due to decreased outdoor activity, potentially limiting

exposure. In contrast, during the summer of 2018, multiple CIV cases occurred at the height of summer travel season on the US east coast, presumably due to increased movement of shedding dogs and/or time spent in boarding facilities, despite the relatively short survival time of the virus during summer months.

CIV remains an ongoing threat to dog populations; however, a combination of diagnostics, contact tracing, and quarantine can be used to limit the extent of an outbreak. Appropriate initial vaccination in conjunction with annual revaccination of at-risk dogs with a licensed H3N2 CIV vaccine remains the best option to prevent severe clinical signs and mortality, especially in older dogs.

… TO YOUR PATIENTS

Key pearls to put into practice:

1. Appropriate diagnostic testing of suspected CIV cases, in conjunction with contact tracing and testing and 28-day isolation periods, is critical to contain outbreaks of CIV.
2. PCR testing on nasal/oropharyngeal swabs and influenza serology may be necessary to trace CIV cases. A PCR-negative unvaccinated dog with a hemagglutinin inhibition titer >1:16 indicates likely exposure to H3N2.
3. Lack of known exposure to another dog exhibiting clinical signs should not rule out CIV infection, as demonstrated in this study in which one case had no known exposure other than using a public walking path.

References

1. Voorhees IEH, Dalziel BD, Glaser A, et al. Multiple incursions and recurrent epidemic fade-out of H3N2 canine influenza A virus in the United States. *J Virol*. 2018;92(16):e00323-18.
2. Dunn D, Creevy KE, Krimer PM. Outcomes of and risk factors for presumed canine H3N2 influenza virus infection in a metropolitan outbreak. *J Am Vet Med Assoc*. 2018;252(8):959-965.

Research Note:
Fluorescence in Situ Hybridization in Dogs with Gallbladder Mucoceles

Gallbladder mucoceles (GBMs) have become a clinically important cause of extrahepatic biliary disease in dogs, particularly in older patients and certain predisposed breeds. The reported percentage of positive bacterial cultures in cases of GBMs, however, has been variable. This study investigated the use of fluorescence in situ hybridization, a culture-independent technique, for detecting bacteria in GBMs. Fluorescence in situ hybridization was found to be more sensitive than bile culture for detecting bacteria. Of the 25 dogs with GBMs in this study, 68% were also found to have concurrent cholecystitis, a higher percentage than has been reported previously in dogs with GBMs (ie, 17%-40%). The relationship among bacteria, cholecystitis, and the etiology and progression of GBMs remains to be determined.

Source

Wennogle SA, Randall EK, Priestnall SL, Twedt DC, Simpson KW. Eubacterial fluorescence in situ hybridisation and histologic features in 25 dogs with gallbladder mucocele. *J Small Anim Pract*. 2019;60(5):291-297.

Research Note:

Clinicopathologic Abnormalities & Animal Triage Trauma Score in Cats with Bite Wounds

Bite wounds are a common type of trauma in cats and can involve deep tissue, muscles, and internal organs, even when the surface wounds appear small. The animal trauma triage (ATT) score measures injury severity by assessing perfusion, cardiac, respiratory, eye/muscle/integument, skeletal, and neurologic status; ATT score has been significantly associated with outcome in dogs and cats. This retrospective study sought to document the clinical and clinicopathologic changes in 43 cats presented with dog-bite trauma and identify significant clinicopathologic changes associated with ATT. Low venous blood pH, high plasma lactate concentration, and low ionized calcium were significantly associated with higher ATT scores on presentation. Early recognition of these changes may help identify bite wound patients with more severe injuries.

Source

Lyons BM, Ateca LB, Otto CM. Clinicopathologic abnormalities associated with increased animal triage trauma score in cats with bite wound injuries: 43 cases (1998–2009). *J Vet Emerg Crit Care*. 2019;29(3):296-300.

See page 42 for product information summary.

BRAVECTO® PLUS

(fluralaner and moxidectin topical solution) for Cats

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

Description:
Each tube is formulated to provide a minimum dose of 18.2 mg/lb (40 mg/kg) fluralaner and 0.9 mg/lb (2 mg/kg) moxidectin. Each milliliter contains 280 mg of fluralaner and 14 mg of moxidectin.

The chemical name of fluralaner is (±)-4-[5-(3,5-dichlorophenyl)-5-(trifluoromethyl)- 4,5-dihydroisoxazol-3-yl]-2-methyl-N-[2-oxo-2-(2,2,2- trifluoroethylamino)ethyl]benzamide. The chemical name of moxidectin is (2aE,4E,5'R, 6R,6'S,8E,11R,13S,15S,17aR, 20R,20aR,20bS)-6'-[(E)-1,3-Dimethyl-1-butenyl]-5',6,6',7,10,11, 14,15,17a,20,20a,20b-dodecahydro-20,20b-dihydroxy-5',6,8,19-tetramethylspiro[11,15-methano-2H,13H,17H-furo[4,3,2-pq][2,6] benzodioxacyclooctadecin-13,2'-[2H]pyran]-4',17(3'H)-dione 4'-(E)-(O-methyloxime). Inactive ingredients: dimethylacetamide, glycofurol, diethyltoluamide, acetone, butylhydroxytoluene

Indications:
Bravecto Plus is indicated for the prevention of heartworm disease caused by *Dirofilaria immitis* and for the treatment of infections with intestinal roundworm (*Toxocara cati*; 4th stage larvae, immature adults and adults) and hookworm (*Ancylostoma tubaeforme*; 4th stage larvae, immature adults and adults). Bravecto Plus kills adult fleas and is indicated for the treatment and prevention of flea infestations (*Ctenocephalides felis*) and the treatment and control of tick infestations [*Ixodes scapularis* (black-legged tick) and *Dermacentor variabilis* (American dog tick)] for 2 months in cats and kittens 6 months of age and older and weighing 2.6 lb or greater.

Dosage and Administration:
Bravecto Plus should be administered topically as a single dose every 2 months according to the **Dosage Schedule** below to provide a minimum dose of 18.2 mg/lb (40 mg/kg) fluralaner and 0.9 mg/lb (2 mg/kg) moxidectin.

For prevention of heartworm disease, Bravecto Plus should be administered at 2-month intervals. Bravecto Plus may be administered year-round without interruption or at a minimum should be administered at 2-month intervals beginning at the cat's first seasonal exposure to mosquitoes and continuing until the cat's last seasonal exposure to mosquitoes. If a dose is missed and a 2-month interval between doses is exceeded, administer Bravecto Plus immediately and resume the dosing every 2 months.

When replacing a monthly heartworm preventative product, the first dose of Bravecto Plus should be given within one month of the last dose of the former medication.

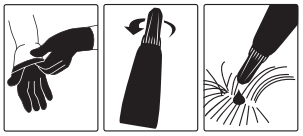
Dosing Schedule:

Body Weight Ranges (lb)	Fluralaner content (mg/tube)	Moxidectin content (mg/tube)	Tubes Administered
2.6 – 6.2	112.5	5.6	One
>6.2 – 13.8	250	12.5	One
>13.8 – 27.5*	500	25	One

* Cats over 27.5 lb should be administered the appropriate combination of tubes.

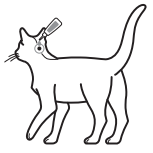
A veterinarian or veterinary technician should demonstrate or instruct the pet owner regarding the appropriate technique for applying Bravecto Plus topically to cats prior to first use.

Step 1: Immediately before use, open the pouch and remove the tube. Put on gloves. Hold the tube at the crimped end with the cap in an upright position (tip up). The cap should be rotated clockwise or counter clockwise one full turn. The cap is designed to stay on the tube for dosing and should not be removed. The tube is open and ready for application when a breaking of the seal is felt.



Step 2: The cat should be standing or lying with its back horizontal during application. Part the fur at the administration site. Place the tube tip vertically against the skin at the base of the skull of the cat.

Step 3: Squeeze the tube and gently apply the entire contents of Bravecto Plus directly to the skin at the base of the skull of the cat. Avoid applying an excessive amount of solution that could cause some of the solution to run and drip off of the cat. If a second spot is needed to avoid run off, then apply the second spot slightly behind the first spot.



Greasy, oily, or wet appearance may occur at the application site in some cats.

Contraindications:
There are no known contraindications for the use of the product.

WARNINGS:

Human Warnings:
Not for human use. Keep this and all drugs out of the reach of children.

Do not contact or allow children to contact the application site until 2 hours post application.

Keep the product in the original packaging until use in order to prevent children from getting direct access to the product. Do not eat, drink or smoke while handling the product. Avoid contact with skin and eyes. If contact with eyes occurs, then flush eyes slowly and gently with water. **If wearing contact lenses, eyes should be rinsed first, then remove contact lenses and continue rinsing, then seek medical advice immediately. Wash hands and contacted skin thoroughly with soap and water immediately after use of the product. If the product accidentally contacts skin and a sticky residue persists after washing, rubbing alcohol (70% isopropyl alcohol) can be applied to the area to remove the residue.**

The product is highly flammable. Keep away from heat, sparks, open flame or other sources of ignition.

Precautions:
For topical use only. Avoid oral ingestion (see **Animal Safety**).

Fluralaner, one of the ingredients in Bravecto Plus, is a member of the isoxazoline class. This class has been associated with neurologic adverse reactions including tremors, ataxia, and seizures. Neurologic adverse reactions have been reported in cats receiving isoxazoline class drugs, even in cats without a history of neurologic disorders. Use with caution in cats with a history of neurologic disorders.

Use with caution in cats that are heartworm positive (see **Animal Safety**).

Bravecto Plus has not been shown to be effective in kittens less than 6 months of age.

The safety of Bravecto Plus has not been established in breeding, pregnant, and lactating cats.

The effectiveness of Bravecto Plus to prevent heartworm disease after bathing or water immersion has not been evaluated.

Adverse Reactions:
In a well-controlled U.S. field study, which included a total of 176 treated cats (135 with Bravecto Plus and 41 with a monthly topical active control), there were no serious adverse reactions.

Percentage of Cats with Adverse Reactions (AR) in the Field Study

Adverse Reaction	Bravecto Plus Group: Percent of Cats with the AR During the 120-Day Study (n=135 cats)	Active Control Group: Percent of Cats with the AR During the 120-Day Study (n=41 cats)
Vomiting	5.9%	12.2%
Alopecia (not at application site)	5.2%	2.4%
Pruritus	4.4%	12.2%
Application site pruritus	4.4%	4.9%
Diarrhea	3.7%	7.3%
Lethargy	3.7%	9.8%
Dry Skin	3.0%	0.0%
Elevated alanine aminotransferase (ALT)*	3.0%	0.0%
Hypersalivation	1.5%	1.5%
Application site alopecia	0.7%	0.0%

*ALT was greater than twice the upper reference range of 100 IU/L. These cats also had mild elevations of aspartate aminotransferase (AST) (less than twice the upper reference range of 100 IU/L). No clinical signs associated with liver disease were noted in these cats.

In well-controlled laboratory effectiveness studies, the following adverse reactions were seen after application of Bravecto Plus: pyrexia, tachypnea, mydriasis, pruritus, scabbing, and bloody stool.

Foreign Market Experience: The following adverse events were reported voluntarily during post-approval use of the product in cats in foreign markets: polydipsia, swelling of chin and lips, periorbital swelling, blepharospasm, pruritus, erythema, aggression, agitation, pyrexia, mydriasis, hypersalivation, hyperactivity, alopecia, and excessive grooming. These adverse events occurred within 48 hours of administration.

In a European field study for fluralaner topical solution for cats, there were three reports of facial dermatitis in humans after close contact with the application site which occurred within 4 days of application. In foreign market experience reports for Bravecto Plus, one veterinarian experienced tingling and numbness of the fingers, hand, and arm, and swelling of the hand and arm after getting Bravecto Plus on her fingers. Additional signs, including blurred vision and disorientation, occurred after taking an antihistamine.

To report suspected adverse events, for technical assistance or to obtain a copy of the Safety Data Sheet (SDS), contact Merck Animal Health at 1-800-224-5318. Additional information can be found at www.bravecto.com. For additional information about adverse drug experience reporting for animal drugs, contact FDA at 1-888-FDA-VETS or online at http://www.fda.gov/reportanimalae.

Clinical Pharmacology:
Peak fluralaner concentrations are achieved between 3 and 21 days following topical administration and the elimination half-life ranges between 11 and 18 days. Peak moxidectin concentrations are achieved between 1 and 5 days following topical administration and the elimination half-life ranges between 20 and 30 days.

Mode of Action:
Fluralaner is for systemic use and belongs to the class of isoxazoline-substituted benzamide derivatives. Fluralaner is an inhibitor of the arthropod nervous system. The mode of action of fluralaner is the antagonism of the ligand-gated chloride channels (gamma-aminobutyric acid (GABA)-receptor and glutamate-receptor).

Moxidectin is for systemic use and is a semisynthetic derivative of nemadectin, belonging to the milbemycin group of macrocyclic lactones. It binds to gamma-aminobutyric acid (GABA) and glutamate-gated chloride channels of the nerves and muscles of the parasite resulting in hyperpolarization, paralysis and death.

Effectiveness:
In two well-controlled laboratory studies, Bravecto Plus was 100% effective against induced heartworm infections when administered 2 months prior to infection. Bravecto Plus was not effective when administered more than 2 months prior to infection.

In well-controlled laboratory studies, Bravecto Plus was effective against naturally and experimentally induced adult and experimentally induced 4th stage larval and immature adult *Toxocara cati* and *Ancylostoma tubaeforme* infections in cats.

In a well-controlled laboratory study, Bravecto Plus killed 100% of fleas within 12 hours after treatment and reduced the numbers of live fleas on cats by >99% within 12 hours after treatment or infestation for 2 months. In well-controlled laboratory studies, Bravecto Plus demonstrated >90% effectiveness against *Dermacentor variabilis* 48 hours after treatment or infestation for 2 months but failed to demonstrate ≥ 90% effectiveness beyond 2 months. In well-controlled laboratory studies, Bravecto Plus demonstrated ≥ 98.1% effectiveness against *Ixodes scapularis* 48 hours after treatment or infestation for 2 months.

Animal Safety:
Margin of Safety Study: In a margin of safety study, Bravecto Plus was administered topically to 9- to 13-week-old (mean age 12 weeks) kittens at 1X, 3X, and 5X the maximum labeled dose of 93.0 mg fluralaner/kg and 4.7 mg moxidectin/kg at three, 8-week intervals (10 kittens per group). The kittens in the control group (0X) were treated with mineral oil. There were no clinically-relevant, treatment-related effects on physical examination, body weights, food consumption, clinical pathology (hematology, clinical chemistries, coagulation tests, serum amyloid A, and urinalysis), gross pathology, histopathology, or organ weights. Single incidences of self-limiting hypersalivation in three kittens (one kitten in the 1X group and two kittens in the 3X group) and pruritus at the administration site in one kitten in the 3X group were observed on the day of dose administration. Cosmetic changes at the application site included matting/clumping/spiking of hair, wetness, or a greasy appearance.

Oral Safety Studies: In an oral safety study, one dose of Bravecto Plus was administered orally to 4- to 9-month-old kittens at the maximum labeled dose of 93.0 mg fluralaner/kg and 4.7 mg moxidectin/kg. The kittens in the control group were administered saline orally. There were no clinically-relevant, treatment-related effects on physical examination, body weights, food consumption, or clinical pathology (hematology, clinical chemistries, coagulation tests, serum amyloid A, and urinalysis). Five of six treated kittens experienced hypersalivation. One treated kitten experienced vomiting 2 hours after administration and another 8 hours after treatment. Treated kittens had reduced food consumption on the day of treatment.

In an oral safety study for fluralaner topical solution for cats, four out of six cats experienced coughing immediately after oral administration of the maximum labeled dose of 93.0 mg fluralaner/kg.

In a pilot oral safety study, adult cats orally administered 0.5X or 1X the maximum labeled dose of Bravecto Plus had foaming hypersalivation for up to five minutes and reduced food consumption on the day of dosing. One cat exhibited transient lacrimation from one eye during the first 15 minutes after dosing.

Safety in cats infected with adult heartworm (Dirofilaria immitis): Bravecto Plus was administered topically to cats infected with adult heartworm at 1X or 3X the maximum labeled dose of 93.0 mg fluralaner/kg and 4.7 mg moxidectin/kg (8 cats per group). The cats in the control group (0X) received mineral oil topically. Two untreated cats were found dead prior to dosing. There were no clinically-relevant, treatment-related effects on body weights, clinical pathology (hematology, clinical chemistry, and coagulation profile), gross pathology or histopathology. Self-limiting hypersalivation due to grooming was observed on the day of treatment in both treatment groups (6/8 cats in the 1X group and 7/8 cats in the 3X group). In addition, three treated cats (2/8 cats in the 1X group and 1/8 cats in the 3X group) developed adverse neurologic signs during the study and were euthanized due to quality-of-life concerns. Clinical signs in one cat in the 1X group included vomiting, depression, vocalization, and ataxia 38 days that included ataxia, paresis, and muscle tremors 25 days after dosing. A cat in the 3X group exhibited depression, dehydration, a hunched position, and inability to stand 22 days after dosing. Heartworms were found in the epidural space in the second cat of the 1X group and the cat in the 3X group.

Field Safety Study: In a well-controlled field study, Bravecto Plus was used concurrently with other medications, such as vaccines, anthelmintics, antibiotics and steroids. No adverse reactions were observed from the concurrent use of Bravecto Plus with other medications.

Storage Conditions:
Do not store above 77°F (25°C). Store in the original package in order to protect from moisture. The pouch should only be opened immediately prior to use.

How Supplied:
Bravecto Plus is available in three tube sizes to treat cats ranging in weight from 2.6 lb – 27.5 lb (1.2 kg to 12.5 kg). Each tube is packaged individually in a pouch. Product may be supplied in 1 or 2 tubes per carton.

Approved by FDA under NADA # 141-518

Rev: 08/2019

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For information, visit BravoVets.com/Plus.

1 Lavan RP et al. *Parasites & Vectors*. 2017;10:284.
2 Lavan RP et al. *Parasites & Vectors*. 2018;11:581.
3 Brakke Consulting. *The US Flea Control and Heartworm Markets*. 2018:6-7.

IMPORTANT SAFETY INFORMATION: The most commonly reported adverse reactions include vomiting, hair loss, itching, diarrhea, lethargy, dry skin, elevated ALT, and hypersalivation. BRAVECTO PLUS has not been shown to be effective for 2 months duration in kittens less than 6 months of age. For topical use only. Avoid oral ingestion. The safety of BRAVECTO PLUS has not been established in breeding, pregnant and lactating cats. Fluralaner is a member of the isoxazoline class. This class has been associated with neurologic adverse reactions including tremors, ataxia, and seizures. Neurologic adverse reactions have been reported in cats receiving isoxazoline class drugs, even in cats without a history of neurologic disorders. Use with caution in cats with a history of neurologic disorders. Use with caution in cats that are heartworm positive. The effectiveness of BRAVECTO PLUS to prevent heartworm disease after bathing or water immersion has not been evaluated.

See page 44 for product information summary.

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[1]Reference on file. Bayer.

WARNING: Keep out of reach of children. CAUTION: Federal law restricts Malaseb® to use by or on the order of a licensed veterinarian. For topical use on dogs, cats and horses. Avoid contact with eyes and mucous membranes.

Intranasal Naloxone Administration in Dogs

Travis Lanaux, DVM, DACVECC
University of Florida

In the Literature

Wahler BM, Lerche P, Pereira CHR, et al. Pharmacokinetics and pharmacodynamics of intranasal and intravenous naloxone hydrochloride administration in healthy dogs. *Am J Vet Res*. 2019;80(7):696-701.

FROM THE PAGE ...

The growing crisis of the abuse of illicit and prescription opioids in humans has led to accidental exposures in pets and working dogs.[1-4] In humans, a commercial intranasal naloxone hydrochloride atomizer is available to treat opioid overdoses and may be purchased without a prescription.[5] There is a growing interest in the use of such atomizers in veterinary patients, particularly for emergency stabilization prior to transporting a patient to a veterinary facility for care.[3,4]

This study compared IV naloxone with intranasal naloxone delivered by a commercially available atomizer in healthy dogs. Time to reach peak plasma levels, maximum concentration, and naloxone half-life were measured and calculated. The intranasal route rapidly achieved clinically useful plasma levels in healthy medium-sized dogs. Naloxone was detectable in plasma 2.3 ± 1.4 minutes after intranasal administration; mean time to maximum concentration in plasma was 22.5 ± 8.2 minutes. Naloxone half-life was similar for both routes of administration (IV, 37 ± 6.7 minutes; intranasal, 47.4 ± 6.7 minutes). It is unclear if nasal conformation (eg, brachycephaly, dolichocephaly) affects intranasal absorption.

Reported adverse effects of naloxone include excitability, vomiting, and tachycardia; however, there were no notable changes in behavior, heart rate, or respiratory rate following naloxone administration by either route in this study.

... TO YOUR PATIENTS

Key pearls to put into practice:

1. Naloxone has a shorter half-life as compared with many opiates.[5-8] Therefore, it should be stressed to pet owners that, in the event of an accidental opioid overdose, veterinary attention should be sought immediately even if naloxone has been administered and the pet has responded well, as the pet will likely require further care.
2. The commercially available naloxone atomizer delivers a single 4-mg dose. The relative body size will likely affect the dose achieved in plasma. Smaller dogs should theoretically achieve higher plasma levels, whereas large- or giant-breed dogs may achieve lower plasma levels.

References

1. Center for Disease Control. Opioids portal. Center for Disease Control website. https://www.cdc.gov/opioids. Accessed August 27, 2019.
2. Kroll D. Fentanyl is also dangerous for law enforcement and dogs. Forbes website. https://www.forbes.com/sites/davidkroll/2016/07/31/fentanyl-also-dangerous-for-law-enforcement-officers-and-dogs/#5ba6754f70d7. Accessed August 27, 2019.
3. Bruce L. PVM provides training on opioid-reversal drug NARCAN to protect police dogs from opioid overdoses. Purdue University website. https://www.purdue.edu/vet/newsroom/2017/pvr-a2017-narcan-training.php. Accessed August 27, 2019.
4. University of Illinois at Urbana Champaign College of Veterinary Medicine. Training video targets overdose in working dogs. University of Illinois at Urbana Champaign College of Veterinary Medicine website. https://vetmed.illinois.edu/training-video-overdose-working-dogs. Accessed August 27, 2019.
5. ADAPT Pharma. NARCAN portal. https://www.narcan.com. Accessed August 27, 2019.
6. Plumb DC. Naloxone. Plumb's Veterinary Drugs website. https://www.plumbsveterinarydrugs.com/#!/monograph/OoTGJbg80T. Updated August 2017. Accessed August 27, 2019.
7. Copland VS, Haskins SC, Patz J. Naloxone reversal of oxymorphone effects in dogs. *Am J Vet Res*. 1989;50(11):1854-1858.
8. Wright AM. Sedative, muscle relaxant, and narcotic overdose. In: Silverstein DC, Hopper K, eds. *Small Animal Critical Care Medicine*. 2nd ed. St Louis, MO: Elsevier Saunders; 2014:400-407.

Dermatologic Diseases in Pet Rats

David Eshar, DVM, DABVP (ECM), DECZM (SM & ZHM)
Kansas State University

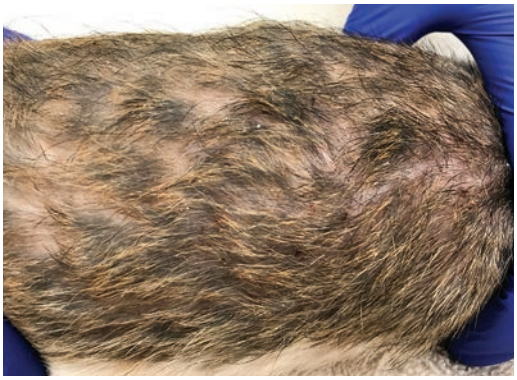
In the Literature

White S, Bourdeau P, Brément T, et al. Companion rats (*Rattus norvegicus*) with cutaneous lesions. *Vet Dermatol*. 2019;30(3):237-242.

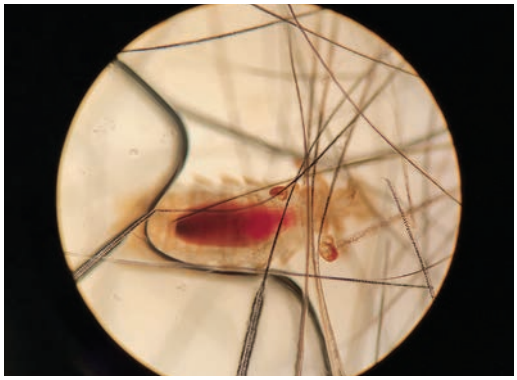
FROM THE PAGE . . .

Because of their gentle character when habituated properly by their owner, rats (*Rattus norvegicus*) have become common household pets.[1] Little preventive care is required for these animals that have relatively short lifespans (ie, 2-3 years), and rats can withstand the problems that come with reduced supervision and suboptimal veterinary care often seen with caged companion mammals relatively well.

In this retrospective review of records from 2 veterinary medical centers, dermatologic conditions seen in pet rats presented for health evaluation were characterized. The study found that skin diseases can make up a large portion (first center, 39%; second center, 47%) of the cases presented for clinical examination and therefore should be added to the list of common conditions seen in pet rats (eg, respiratory infections, mammary gland neoplasia).



▲ **FIGURE 1** Pet rat presented for alopecia, pruritus, and crusting over the dorsum



▲ **FIGURE 2** Microscopic examination of a skin scrape and collected hair from the affected area of the patient in Figure 1 revealed blood-filled lice.

Dermatologic diseases in pet rodents have been reported.[2-5] Because pruritus is one of the most common clinical signs associated with dermatopathies in pet rodents, timely diagnosis and treatment is required for resolution. In this study, nodules, alopecia, and crusts were also commonly noted. Pododermatitis was also frequently observed, and obesity, poor diet, wire-bottom caging, and excessive use of running wheels were identified as risk factors for this condition.

Many health issues in pet rats result from suboptimal husbandry (ie, environment, diet). A thorough review of husbandry is required for successful diagnosis and treatment of rat dermatoses. Any husbandry deficiencies, once identified, should be addressed and environmental treatments implemented to prevent recurrence and control parasitic infections.[2]

A detailed dermatologic examination is necessary in all rats presented with skin disease, and the methods described in this study are all commonly used in other companion mammals. However, some owners may decline to perform a wide array of tests, so empiric treatments may be required for presumptive diagnoses; the data from this study suggest that this practice should be discouraged. Furthermore, empiric treatments based on assumptions of what is "common" should be discouraged, as disease occurrence can differ based on geography. Basic diagnostic testing can help ensure accurate and timely diagnosis and resolution for affected patients.

… TO YOUR PATIENTS

Key pearls to put into practice:

1. Fecal testing of both clinical and subclinical patients can often reveal the presence of ecto- and endoparasites and should be performed routinely in all rat patients.
2. If owners decline skin testing or if other tests fail to provide a diagnosis, a full-thickness punch biopsy can be the most helpful test to perform. For example, a 2-mm punch biopsy can be collected with brief anesthesia and a local anesthetic block and the skin later closed with a drop of surgical glue.
3. Clinicians should be aware that rats are particularly sensitive to repeat intradermal injections, especially when potentially irritating substances (eg, enrofloxacin, ketamine) are administered.

References

1. American Veterinary Medical Association. US pet ownership statistics. In: *US Pet Ownership & Demographics Sourcebook*. Schaumburg, IL: American Veterinary Medical Association: 2012.
2. Palmeiro BS, Roberts H. Clinical approach to dermatologic disease in exotic animals. *Vet Clin North Am Exot Anim Pract*. 2013;16(3):523-577.
3. Hoppmann E, Barron HW. Rodent dermatology. *J Exot Pet Med*. 2007; 16(4):238-255.
4. Hill PB, Lo A, Eden CAN, et al. Survey of the prevalence, diagnosis and treatment of dermatological conditions in small animals in general practice. *Vet Rec*. 2006;158(16):533-539.
5. Miller WH, Griffin CE, Campbell KL. Dermatoses of exotic small mammals. In: Miller WH, Griffin CE, Campbell KL, eds. *Muller & Kirk's Small Animal Dermatology*. 7th ed. Philadelphia, PA: WB Saunders: 2013;844-887.

If owners decline skin testing or if other tests fail to provide a diagnosis, a full-thickness punch biopsy can be the most helpful test to perform.

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R. Darren Wood, DVM, DVSc, DACVP (Clinical Pathology)
University of Guelph
Ontario, Canada

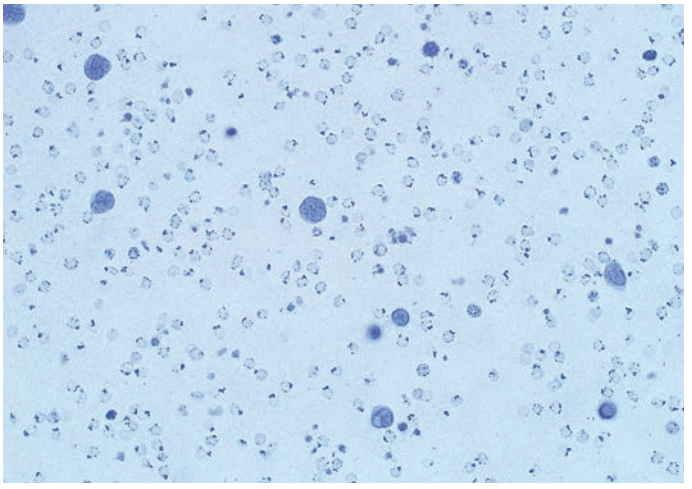
In the Literature

Dondi F, Vasylyeva K, Serafini F, et al. Heinz body-related interference with leukocyte and erythrocyte variables obtained by an automated hematology analyzer in cats. *J Vet Diagn Invest*. 2019;31(5):704-713.

FROM THE PAGE ...

Heinz bodies can occur at low levels in RBCs in clinically healthy cats.[1] Exposure to oxidizing agents (eg, acetaminophen, onion-containing foods) or presence of certain underlying diseases (eg, diabetes mellitus, hyperthyroidism) can increase the frequency of Heinz body occurrence, sometimes affecting >50% of cells (***Figure***). The presence of these structures on erythrocytes can interfere with automated CBC analysis, resulting in erroneous interpretations without careful inspection.

This retrospective study sought to determine whether examination of hematology analyzer graphs and data raised suspicion for presence of Heinz bodies and to document changes over time in patients with Heinz bodies. Data from 32 cats were obtained through a flow-cytometry–based automated hematology analyzer and results of microscopic examination of blood smears. Results showed that the presence of Heinz bodies on >36% of erythrocytes resulted in artifacts that impacted the ability of the automated analyzer to accurately determine WBC count. This was detected as an abnormality on the graphs



▲ **FIGURE** Blood smear from a cat with Heinz body hemolytic anemia. The sample was stained with new methylene blue to highlight the inclusions, which are present in the majority of erythrocytes. The larger blue structures are leukocytes. *Magnification 400×*

Continues ▶

produced by the analyzer and confirmed on blood smear examination. As cats recovered and the percentage of inclusion-containing erythrocytes declined, the interference with obtaining a proper WBC count became minimal.

The effect of Heinz bodies on the measurement of hemoglobin variables has been described.[2] Inclusions result in increased optical density of the affected erythrocytes, which increases mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration as detected by a laser. RBCs cannot contain additional hemoglobin above physiologic amounts, so increases in these variables should always raise suspicion for artifacts.

Although the hematology instrument used in this study is not commonly used in general practice, other hematology analyzers could also produce interference, as reported in this study. Any clinic that maintains hematology laboratory equipment should have procedures in place to assure quality and accuracy of results to prevent erroneous interpretation of data when interferences such as Heinz bodies are present in a blood sample. Blood smear examination is crucial in any ill patient that has hematologic abnormalities.

. . . TO YOUR PATIENTS

Key pearls to put into practice:

1. Feline blood samples in which >36% of erythrocytes contain Heinz bodies may cause analytic errors with certain hematology instruments.
2. Heinz body interferences most commonly impact certain hemoglobin measurements and may also result in overestimation of WBC count.
3. If laboratory results do not correlate with clinical signs or make physiologic sense, the possibility of analytic error should be pursued.

References

1. Harvey JW. Evaluation of erythrocytes. In: Harvey JW. *Veterinary Hematology: A Diagnostic Color Guide and Atlas*. St. Louis, MO: Elsevier Saunders; 2012:79-81.
2. Tvedten H, Moritz A. Reticulocyte and Heinz body staining and enumeration. In: Weiss DJ, Wardop KJ, eds. *Schalm's Veterinary Hematology*. 6th ed. Ames, IA: Wiley-Blackwell; 2010:1067-1073.

Research Note: **Oxyclozanide as Treatment for Small Animal Bacterial Pathogens**

Repurposing existing drugs and using a topical antimicrobial as a first-line treatment option for superficial pyoderma can help promote good antimicrobial stewardship, protect the efficacy of newer systemic antimicrobial classes, and limit use of newer antimicrobial classes. The aim of this study was to provide proof-of-concept for repurposing the drug oxyclozanide, a salicylanilide anthelmintic used primarily in humans and ruminants, as a topical treatment option for superficial pyoderma in small animals. Results showed promising in vitro activity against both methicillin-sensitive and methicillin-resistant *Staphylococcus pseudintermedius* canine isolates. Pilot data from this study may help guide clinical studies of topical application of oxyclozanide.

Source

Levinson MR, Blondeau JM, Rosenkrantz WS, Plowgian CB. The in vitro antibacterial activity of the anthelmintic drug oxyclozanide against common small animal bacterial pathogens. *Vet Dermatol*. 2019;30(4):314-e87.

Results showed promising in vitro activity against both methicillin-sensitive and methicillin-resistant *Staphylococcus pseudintermedius* canine isolates.

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Pulmonary Hypertension in Dogs

Douglas Palma, DVM, DACVIM
The Animal Medical Center
New York, New York

In the Literature

Jaffey JA, Wiggen K, Leach SB, Masseau I, Girens RE, Reinero CR. Pulmonary hypertension secondary to respiratory disease and/or hypoxia in dogs: clinical features, diagnostic testing and survival. *Vet J*. 2019;251:105347.

FROM THE PAGE ...

Pulmonary hypertension is a common respiratory disorder in dogs and can be caused by various disorders with different pathophysiologic mechanisms. In clinical practice, the most common causes of pulmonary hypertension include left-sided heart disease and pulmonary arterial hypertension associated with respiratory disease and/or hypoxemia (RD/H). Despite the seemingly high prevalence of RD/H-associated pulmonary hypertension, little is known about its clinical presentation, diagnostic characteristics, prognostic variables, therapeutic responsiveness, and/or long-term outcome.

This retrospective study evaluated patients that had RD/H-associated pulmonary hypertension documented on echocardiogram. The mechanism of each patient's respiratory disease was characterized based on available diagnostic testing. The population was diverse and included both obstructive and restrictive disease processes.

The authors suggested a correlation between the severity of estimated pulmonary arterial pressures and patient outcome. Furthermore, intervention with phosphodiesterase-5 (PDE5) inhibitors was demonstrated to improve survival time. Although this information is preliminary and represents cumulative information of a diverse population, it shows that patients with RD/H-associated pulmonary hypertension could benefit from PDE5 inhibitors and that echocardiogram could potentially provide prognostic information.

This study provides a basis for additional studies. It demonstrates the variability in associated underlying etiologies and can help guide clinicians in identification of patients at risk for pulmonary hypertension. Additional studies evaluating therapy in subset groups will be necessary to optimize therapy and establish a better understanding of long-term outcome and progression.

… TO YOUR PATIENTS

Key pearls to put into practice:

1. Estimated systolic pulmonary arterial pressure (sPAP) is negatively correlated with survival. A sPAP ≥47 mm Hg has a sensitivity of 78% and a specificity of 63% for nonsurvival; a sPAP >95 mm Hg has a specificity of 95% and a sensitivity of 17% for nonsurvival.

2. Treatment with a PDE5 inhibitor (ie, tadalafil, sildenafil) may help improve survival, as observed in this study. Patients that received PDE5 inhibitors (ie, tadalafil [median dose, 2 mg/kg PO every 24 hours; range, 0.9-2 mg/kg], sildenafil [median dose, 0.5 mg/kg PO every 8 hours; range, 0.5-3.3 mg/kg]) were 4 times more likely to survive as compared with patients that did not receive PDE5 inhibitors.

3. RD/H-associated pulmonary hypertension represents a diverse population of respiratory conditions, including restrictive and obstructive disorders (eg, conducting airways [ie, nasal/nasopharyngeal, laryngeal, trachea and mainstem bronchi], large airway obstruction [ie, bronchi], small airways [ie, bronchioles]).

Suggested Reading

Bach JF, Rozanski EA, MacGregor J, Betkowski JM, Rush JE. Retrospective evaluation of sildenafil citrate as a therapy for pulmonary hypertension in dogs. *J Vet Intern Med*. 2006;20(5):1132-1135.

Brown AJ, Davison E, Sleeper MM. Clinical efficacy of sildenafil in treatment of pulmonary arterial hypertension in dogs. *J Vet Intern Med*. 2010;24(4):850-854.

Kellihan HB, Stepien RL. Pulmonary hypertension in canine degenerative mitral valve disease. *J Vet Cardiol*. 2012;14(1):149-164.

Kellihan HB, Stepien RL. Pulmonary hypertension in dogs: diagnosis and therapy. *Vet Clin North Am Small Anim Pract*. 2010;40(4):623-641.

Kellum HB, Stepien RL. Sildenafil citrate therapy in 22 dogs with pulmonary hypertension. *J Vet Intern Med*. 2007;21(6):1258-1264.

Murphy LA, Russell N, Bianco D, Nakamura RK. Retrospective evaluation of pimobendan and sildenafil therapy for severe pulmonary hypertension due to lung disease and hypoxia in 28 dogs (2007-2013). *Vet Med Sci*. 2017;3(2):99-106.

Paradies P, Spagnolo PP, Amato ME, Pulpito D, Sasanelli M. Doppler echocardiographic evidence of pulmonary hypertension in dogs: a retrospective clinical Investigation. *Vet Res Commun*. 2014;38(1):63-71.

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- ✓ PUREVAX offers THE ONLY **recombinant** nonadjuvanted Feline Leukemia Virus (FeLV) vaccine

[1] Poulet H, Minke J, Pardo MC, Juillard V, Nordgren B, Audonnet JC. Development and registration of recombinant veterinary vaccines. The example of the canarypox vector platform. *Vaccine.* 2007;25(30):5606-5612.

[2] Greene CE, Schultz RD. Immunoprophylaxis. In: Greene CE, ed. *Infectious Diseases of the Dog and Cat.* 4th ed. St Louis, MO: Elsevier Saunders; 2012:1166-1169.

[3] Taylor J, Meignier B, Tartglia J, et al. Biological and immunogenic properties of canarypox-rabies recombinant ALVACRG (vCP65) in non-avian species. *Vaccine.* 1995; 13;6;539-549.

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DJ Haeussler Jr, DVM, MS, DACVO
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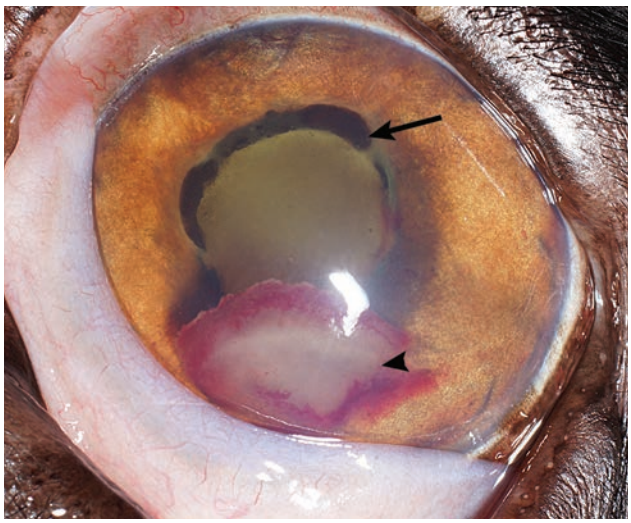
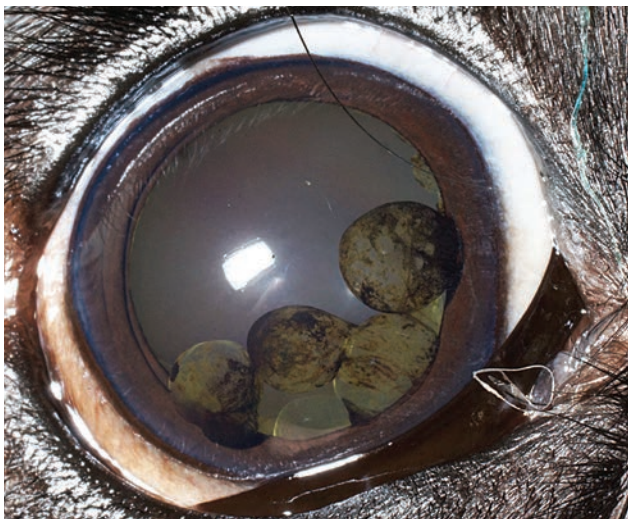
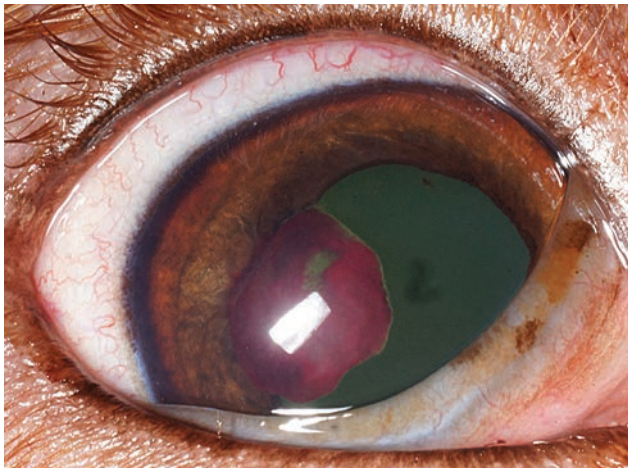
Evaluation of the iris and anterior chamber should be a routine part of every physical examination. A light source should always be used during this evaluation.



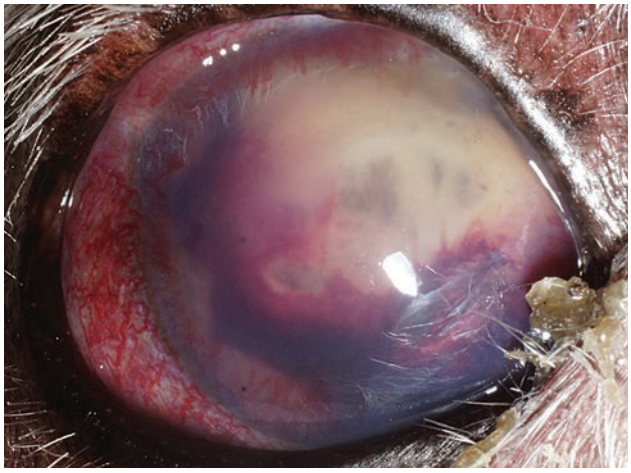
▲ **FIGURE 1** Left eye of a 9-year-old neutered male Bernese mountain dog presented for uveitis and secondary glaucoma. Examination showed a diffusely thickened iris with ectropion uvea (ie, pupillary margin and posterior surface of the iris protrude anteriorly; ***arrow***). Hyphema and fibrin (***arrowhead***) were admixed in the ventral anterior chamber. Histopathologic evaluation of the enucleated eye revealed an iris melanoma.



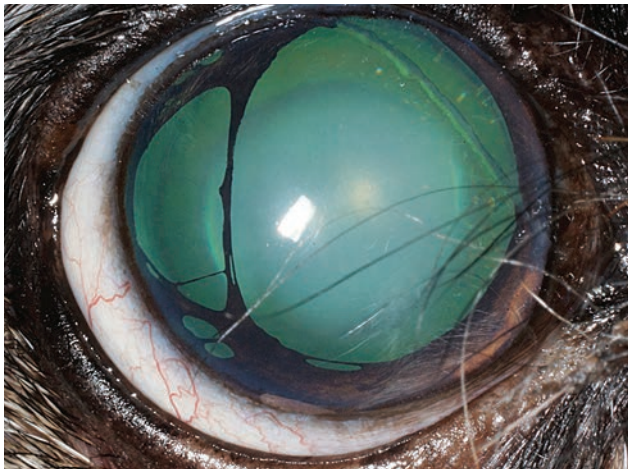
▲ **FIGURE 2** Multiple translucent uveal cysts in the right eye of a 4-year-old spayed bull mastiff. These cysts are benign but can rupture in the eye and leave pigment deposition. Because they can float freely in the anterior chamber, uveal cysts are assumed to occasionally cause vision obstruction and abnormal behavior patterns (eg, fly-biting, headshaking). In such cases, a veterinary ophthalmologist can perform transpupillary cyclophotocoagulation, a noninvasive procedure that involves general anesthesia and use of an indirect ophthalmoscopy head unit to coagulate and shrink the cyst via laser.



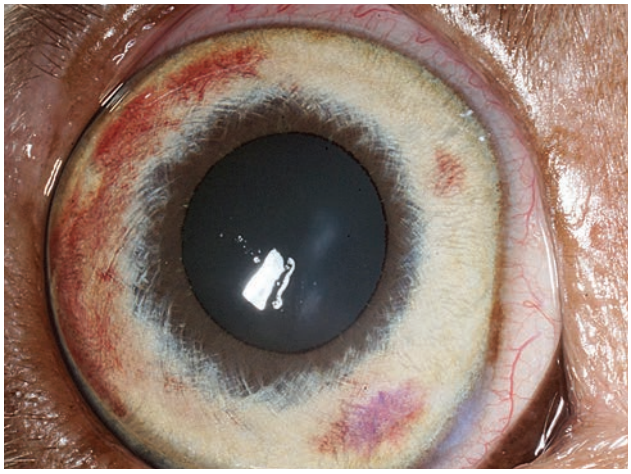
▲ **FIGURE 3** Blood clot in the anterior chamber of the right eye of a 4-year-old neutered male crossbreed dog with hyperadrenocorticism. This patient was presented with a large blood clot in the anterior chamber and subretinal hemorrhage; blood pressure at the time of examination (210 mm Hg) revealed concurrent systemic hypertension. Antihypertensive and topical anti-inflammatory drugs were administered.



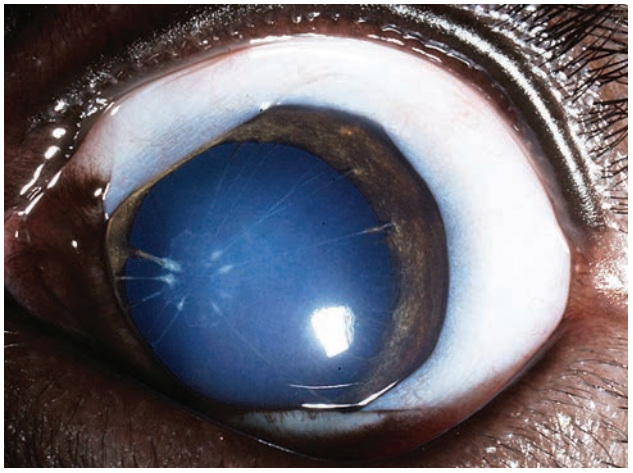
▲ **FIGURE 4** Right eye of a 9-year-old neutered male West Highland white terrier presented for hyphema and fibrin in the anterior chamber, deep corneal vascularization, episcleral injection, and secondary glaucoma. Histopathologic evaluation of the enucleated eye confirmed lymphoma. Although the patient's peripheral lymph nodes were subjectively normal, abdominal ultrasonography revealed enlarged mesenteric lymph nodes.



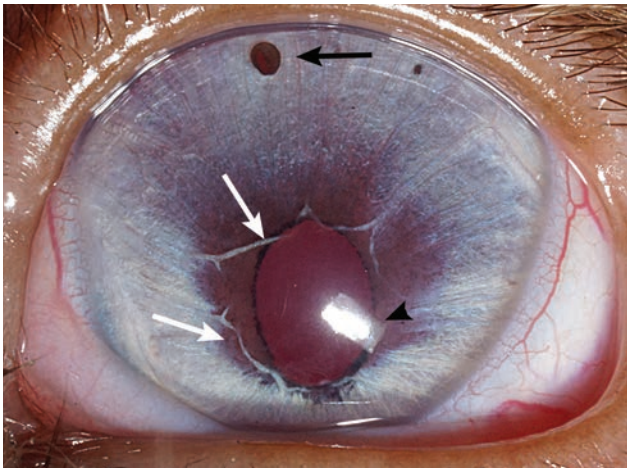
▲ **FIGURE 5** Right eye of a 12-year-old spayed Jack Russell terrier presented with an irregular iris surface with "tattered" and "torn" areas, through which irregular openings of tapetal reflection can be seen. Ophthalmologic evaluation revealed iris atrophy, a condition primarily found in older patients. Iris atrophy can result in decreased or sluggish pupillary light responses and cause squinting in bright light.



▲ **FIGURE 6** Iris stromal hemorrhage in the right eye of a 3-year-old crossbreed dog. After a thorough ophthalmologic examination, CBC showed a markedly decreased platelet count consistent with immune-mediated thrombocytopenia. Iris stromal hemorrhage resolved after the patient received therapy (ie, oral prednisone, oral azathioprine) for immune-mediated thrombocytopenia.



▲ **FIGURE 7** Persistent pupillary membranes in the left eye of an 11-year-old spayed bull mastiff presented with an abnormal iris. Ophthalmologic examination revealed persistent pupillary membranes (ie, strands of remnant fetal membranes originating from the iris collarette that supplied the lens with nutrients prior to birth) extending from the iris to the anterior lens capsule, creating fibrotic plaques on the capsule. Although not likely to resolve, persistent pupillary membranes will not result in vision loss or further abnormal changes to the eye.



▲ **FIGURE 8** Merle ocular dysgenesis in the left eye of a 14-month-old merle Australian shepherd dog presented with an abnormal eye. Clinical signs included iris-to-iris persistent pupillary membranes (***white arrows***), corectopia (ie, displacement of the pupil [ventrally in this patient]; ***arrowhead***), and iris coloboma (ie, congenital hole in the iris; ***black arrow***). Patients with merle ocular dysgenesis may also experience microphthalmia, cataracts, lens colobomas, optic nerve colobomas, and scleral colobomas.

Patients with merle ocular dysgenesis may also experience microphthalmia, cataracts, lens colobomas, optic nerve colobomas, and scleral colobomas.

Suggested Reading

Gelatt KN, Gilger BC, Kern TJ, eds. *Veterinary Ophthalmology.* 5th ed. Ames, IA: John Wiley & Sons; 2013.

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- Case: Acute Pleural Effusion in a Dog
- Step-by-Step Fundic Examination
- Hemangiosarcoma Review
- Jaw Fractures

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Tooth Fracture

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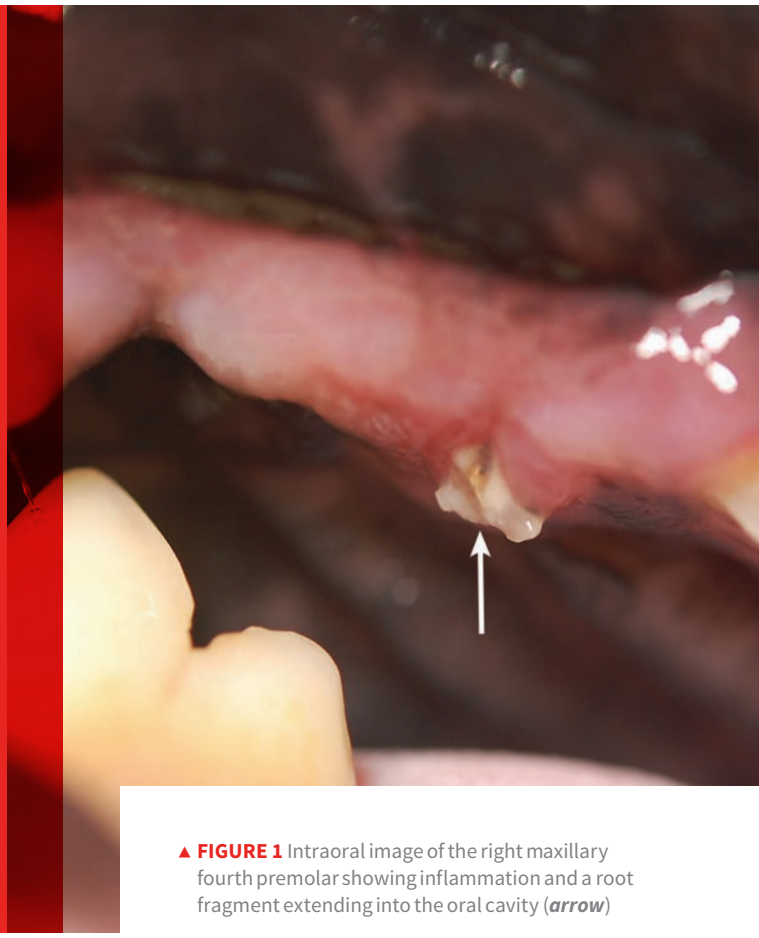


▲ **FIGURE 1** Intraoral image of the right maxillary fourth premolar showing inflammation and a root fragment extending into the oral cavity (***arrow***)

THE CASE

Sam, a 12-year-old retriever, was presented for owner-observed signs of pain while eating (ie, moving food in his mouth to chew, occasional vocalization). His owners reported that he also exhibited other signs, including aggressively chewing on multiple objects.

On physical examination, recent, unilateral, mild hemorrhage of the lip commissure was identified. An uncomplicated crown fracture of the right maxillary fourth premolar (with the fragment extending into the gum) was presumptively diagnosed. The tooth fragment was removed with the patient under general anesthesia. Because the pulp was apparently not directly exposed, no further treatment was performed. Dental radiography was not performed.

Sam was presented again a few months later for swelling below his right eye. An abscess from the right maxillary fourth premolar was presumptively diagnosed, and the tooth was sectioned and removed with a closed extraction technique. Dental radiography, again, was not performed.

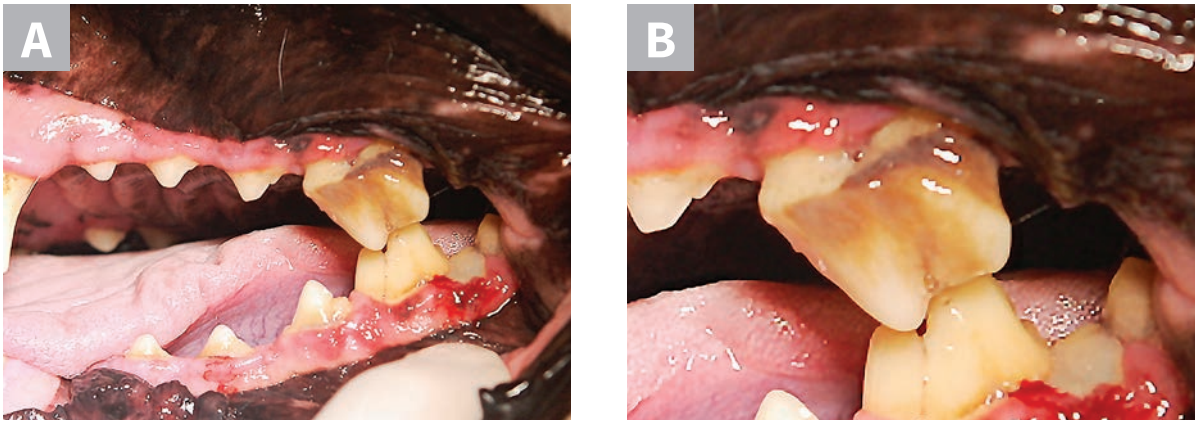
After several months, the oral wound had not healed appropriately, and the patient demonstrated apparent continued discomfort, especially while eating. He was referred to a specialist for further treatment. Oral examination on referral revealed that the extraction site of the right maxillary fourth premolar was unhealed, with a root fragment extending from the inflamed gingiva (***Figure 1***).

Diagnostics

A full physical examination with preoperative testing (ie, CBC, serum chemistry profile, urinalysis) revealed no significant abnormalities. A complete oral examination and full-mouth radiography were performed with the patient under general anesthesia.

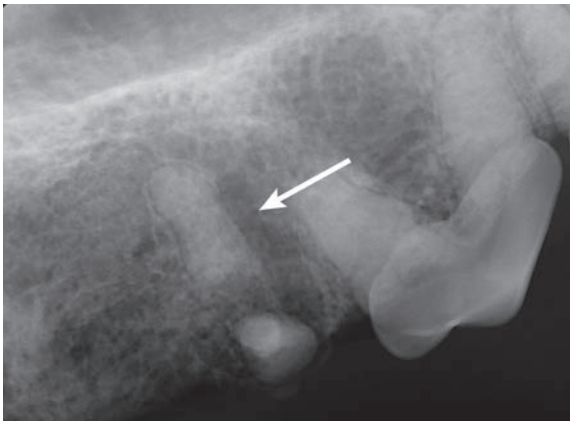
Oral examination confirmed an unhealed extraction site of the right maxillary fourth premolar with a root fragment protruding into the oral cavity. Periodontal disease of the left maxillary fourth premolar (***Figure 2***) and a complicated crown fracture of the right maxillary canine (***Figure 3***) were also identified.

Dental radiographs confirmed the root fragment of the right maxillary fourth premolar had been retained (***Figure 4***). Periapical rarefaction (ie, periapical lucency) and periodontal disease of the right maxillary canine were also confirmed on radiographs; comparison with the contralateral left maxillary canine revealed that the canine tooth had been nonvital for several months, as the



▲ **FIGURE 2** Intraoral image (***A***) and close-up view (***B***) of the left maxillary fourth premolar showing signs of advanced periodontal disease. Gingivitis, gingival recession, furcation involvement of the left maxillary fourth premolar, and gingivitis of the third and fourth mandibular premolars and the first mandibular molar can be seen.

▲ **FIGURE 3** Intraoral image of the right maxillary canine showing a previous complicated crown fracture (***arrow***)



▲ **FIGURE 4** Intraoral radiograph of the right maxillary fourth premolar showing a root fragment (***arrow***)

pulp cavity of the right maxillary canine had failed to narrow (***Figures 5*** and ***6***).[1] Dental radiographs of the left maxillary fourth premolar revealed fractures of the mesiobuccal and mesiopalatinal roots in addition to advanced periodontal disease of the distal root (***Figure 7***, next page).

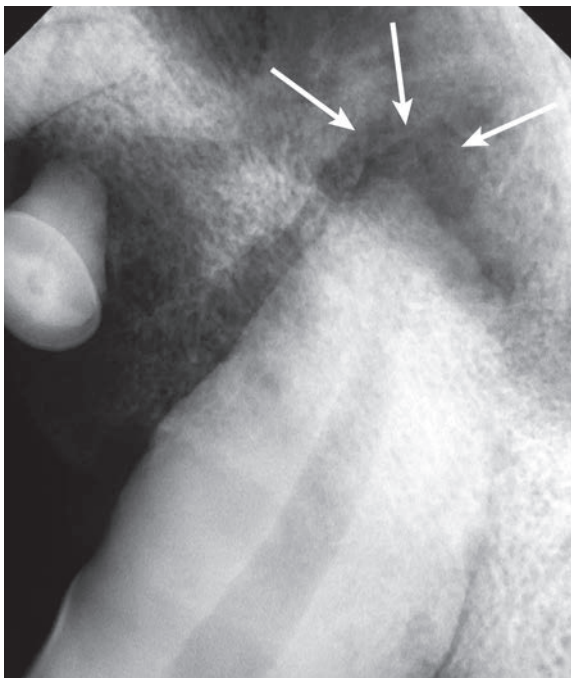
Treatment & Follow-Up

After the remaining teeth were cleaned, maxillary nerve blocks were performed and IV analgesia administered as part of a multimodal analgesia approach. Surgical extractions—which included removal of the mucogingival flaps and buccal bones and closure of the surgical sites—of the maxillary fourth premolars and the right maxillary canine were performed.[2]

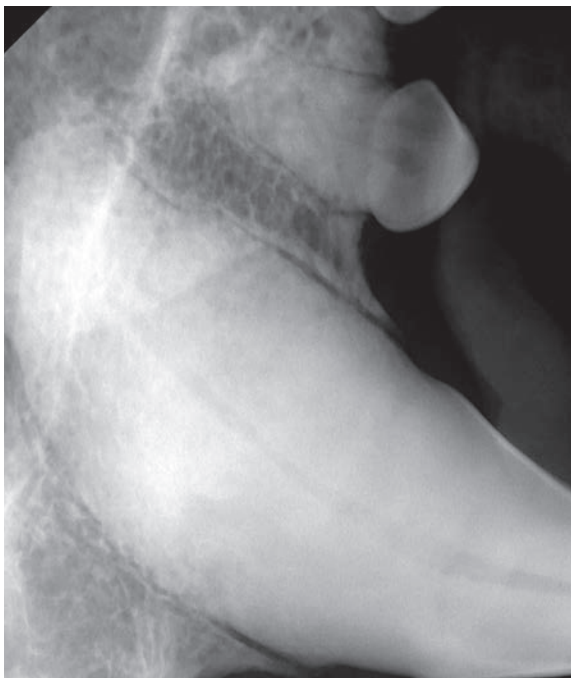
Sam was discharged the same day on an oral NSAID to be administered daily for the next 4 days. His recovery was uneventful, and he started eating soft food the day after surgery.

Discussion

Tooth fractures are common in dogs and cats and



▲ **FIGURE 5** Intraoral radiograph of the right maxillary canine showing periapical lucency (***arrows***) and a wide pulp chamber, which is unusual in dogs this age, that indicates the tooth is nonvital



▲ **FIGURE 6** Intraoral radiograph of the left maxillary fourth canine showing healthy periapical tissue and a narrow pulp, as expected at this dog's age

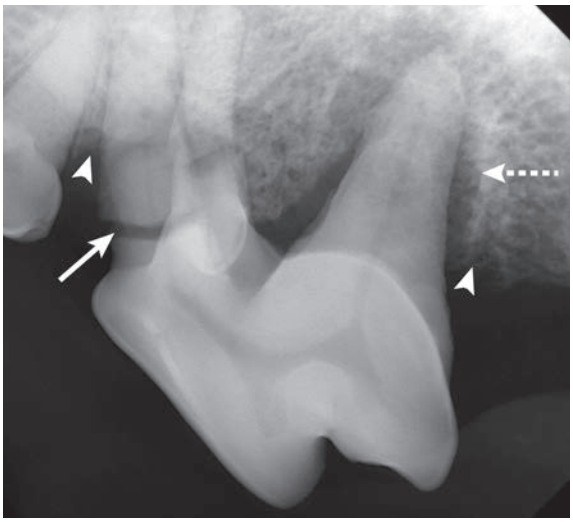
All vital teeth with direct pulp exposure are painful.

are typically incidental findings. In a study, fractured teeth were diagnosed in ≈50% of companion animals.[3]

Classification of Tooth Fractures

Tooth fractures can be classified based on the amount of tooth structure (ie, enamel, dentin, cementum) exposed and whether the dental pulp tissue is directly exposed. An injury that does not expose the pulp is considered uncomplicated; direct pulp exposure is considered complicated.[4]

All vital teeth with direct pulp exposure are painful.[5] The exposed pulp may become infected by oral bacteria, which can lead to pulpitis and pulp necrosis.

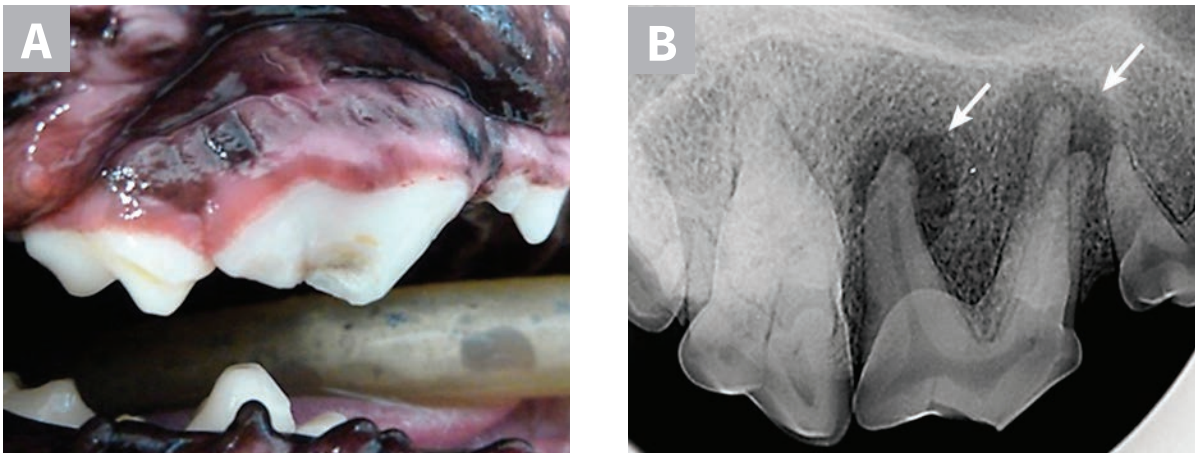


▲ **FIGURE 7** Intraoral radiograph of the left maxillary fourth premolar showing fracture of a mesial root (***arrow***) and advanced periodontal disease with horizontal bone loss (***arrowheads***) and vertical bone loss around the distal root (***dashed arrow***)

Uncomplicated Tooth Fractures

Special attention should be paid to uncomplicated crown fractures, as progressive clinical implications are typically underestimated. Dentinal tubules are exposed in almost all cases of uncomplicated crown fractures and can have several consequences:

- Pain can be felt due to dentinal sensitivity.[6]
- Bacteria can penetrate the tubules and infect the pulp without direct exposure of the pulp, resulting in pulpitis and pulp necrosis.[7] Infection can extend through the apical delta and affect the periapical bone (ie, periapical rarefaction; ***Figure 8***), which has been reported to occur in 24.3% of uncomplicated fractures of maxillary fourth premolars.[8] If not recognized, the disease may end in abscessation with typical swelling (***Figure 9***) or in a fistula.
- The rough surface of a fractured tooth enables faster plaque and calculus accumulation, which can hasten the onset of periodontal disease.



▲ **FIGURE 8** Intraoral image of a right maxillary fourth premolar with an uncomplicated crown fracture (***A***) and the correlating intraoral radiograph showing advanced periapical rarefaction (***B***; ***arrows***)

Diagnosis & Treatment

Because the appearance of the crown does not always correlate with what is happening below the gumline, dental exploration and radiography are necessary for thorough examination of a fractured tooth. Uncomplicated crown fractures that appear harmless can have severe endodontic consequences seen on dental radiographs (***Figure 8***).[9] Treatment options are directly related to the type and degree of damage, as well as the presence or absence of endodontic disease.[10] Any complicated fracture (ie, involving direct pulp exposure) should be treated via extraction or root canal therapy. If a therapeutic delay is necessary, pain management should be provided until surgery can be performed; antibiotics are typically not indicated in these cases.[11]

Treatment for dentin exposure (ie, uncomplicated fracture) is recommended to reduce sensitivity, block the pathway for infection, and smooth out the tooth, which should decrease periodontal disease.[12]

Dental radiography should be performed prior to treatment to ensure there is no existing endodontic disease. If evidence of endodontic inflammation and/or infection is noted on dental radiographs, root canal therapy or extraction is typically required.

Animal Welfare Relevance

Animals rarely show signs of oral pain, despite their nociceptive pathways functioning similarly to those of humans.[13] Clinicians are responsible for recognizing when an animal is in pain and reacting accordingly. The intense pain from pulp exposure and the long duration required for an infection to develop outward clinical signs are of great animal welfare relevance. Animal welfare is gaining in importance, and neglecting guidelines may lead to future consequences.

Conclusion

Sam's case demonstrates the importance of quickly performing a full dental examination, including dental radiography, with the patient under general anesthesia. Clinicians should have the minimum equipment and expertise needed if dental procedures are expected to be performed. Referral should be considered if the clinician is not properly equipped to handle these dental conditions.

Continues ▶

▲ **FIGURE 9** Swelling (***arrow***) due to advanced periapical rarefaction

Animals rarely show signs of oral pain, despite their nociceptive pathways functioning similarly to those of humans.

ASK YOURSELF ...

QUESTION 1

Which of the following is true when defining a complicated tooth fracture?

A. Only enamel is exposed.
B. Enamel and dentin are exposed.
C. Enamel, dentin, and the pulp are exposed.
D. The crown and root are affected without pulp exposure.

CORRECT ANSWER: C

In a complicated tooth fracture, the pulp is exposed. Tooth fractures without exposure of the pulp are considered uncomplicated.

QUESTION 2

An uncomplicated crown fracture _____.

A. Can lead to pulpitis
B. Does not cause pain
C. Does not require further examination
D. Does not require treatment

CORRECT ANSWER: A

Dentinal tubules are exposed in most uncomplicated crown fractures, which can be painful. In addition, bacteria can penetrate the pulp and cause pulpitis, leading to a periapical abscess.

QUESTION 3

Examination of a fractured tooth should include which of the following?

A. Tactile examination using a probe
B. Visual examination using magnification
C. Radiography
D. All of the above

CORRECT ANSWER: D

Full examination of a tooth fracture includes visual and tactile (ie, using a dental explorer) examination, as well as dental radiography that can be used to estimate damage.

QUESTION 4

Which of the following is true regarding treating complicated tooth fractures?

A. They should not be treated in animals, as animals can handle more pain than humans.
B. They should always be treated.
C. They should not be treated if the patient is eating.
D. These do not occur in animals.

CORRECT ANSWER: B

Many animals do not show obvious clinical signs of pain and, therefore, do not receive treatment. Because their nociceptive pathways are the same as in humans, it can be presumed that animals feel the same pain as humans. Tooth fractures should be treated to prevent pain and further pathology, including pulpitis, periapical and periradicular infections, and tooth loss.

QUESTION 5

A nonvital tooth may be recognized by which of the following clinical signs?

A. Intrinsic staining
B. Lack of growth/eruption
C. Periapical lucency (ie, periapical rarefaction)
D. None of the above

CORRECT ANSWER: D

Tooth vitality can be determined on dental radiographs. Widening of the pulp cavity in a nonvital tooth can typically be determined by comparing radiographs of the affected tooth with the contralateral tooth. Periapical lucency (ie, periapical rarefaction) may be a sign of pulp necrosis extending to the periapical bone but can also be a sign of apical granuloma or apical cysts in vital teeth. Intrinsic staining may be an indicator of tooth necrosis/nonvitality but may also be seen in vital teeth that have been traumatized and have pulpal hemorrhage due to tetracycline staining in young animals that received antibiotics or in teeth undergoing internal resorption. Lack of growth or eruption may be due to trauma, infection, cyst formation, neoplasia, and/or impaction when the tooth is still vital.

References

1. Fiani N, Arzi B. Diagnostic imaging in veterinary dental practice. Endodontic disease. *J Am Vet Med Assoc*. 2010;236(1):41-43.
2. Lommer MJ, Verstraete FJM, Tsugawa AJ. Exodontics. In: Verstraete FJM, Lommer MJ, eds. *Oral and Maxillofacial Surgery in Dogs and Cats*. Philadelphia, PA: Saunders Elsevier; 2012:97-159.
3. Reiter AM. Commonly encountered dental and oral pathologies. In: Reiter AM, Gracis M, eds. *BSAVA Manual of Canine and Feline Dentistry and Oral Surgery*. Quedgeley, UK: BSAVA; 2018:89-119.
4. Niemiec BA. How to address and stabilize dental emergencies. In: Niemiec BA. *Veterinary Dentistry Applications in Emergency Medicine and Critical or Compromised Patients*. San Diego, CA: Practical Veterinary Publishing; 2012:1-32.
5. Theuns P, Niemiec BA. Bonded sealants for uncomplicated crown fractures. *J Vet Dent*. 2011;28(2):130-132.
6. Soukup JW, Hetzel S, Paul A. Classification and epidemiology of traumatic dentoalveolar injuries in dogs and cats: 959 injuries in 660 patient visits (2004-2012). *J Vet Dent*. 2015;32(1):6-14.
7. American Veterinary Dental College. AVDC nomenclature. AVDC website. https://avdc.org/avdc-nomenclature. Accessed September 2019.
8. Bender IB. Pulpal pain diagnosis—a review. *J Endod*. 2000;26(3):175-179.
9. Brännström M. Sensitivity of dentine. *Oral Surg Oral Med Oral Pathol*. 1966;21(4):517- 526.
10. Love RM, Jenkinson HF. Invasion of dentinal tubules by oral bacteria. *Crit Rev Oral Biol Med*. 2002;13(2):171-183.
11. Goodman AE, Niemiec BA, Carmichael DT. The incidence of radiographic lesions of endodontic origin associated with uncomplicated crown fractures of the maxillary fourth premolars in canine patients. *J Vet Dent*. In press.
12. Niemiec BA. The importance of dental radiology. *Eur J Comp Anim Pract*. 2011;20(3):219-229.
13. WSAVA Global Pain Council. Guidelines for recognition, assessment and treatment of pain. WSAVA website. https://www.wsava.org/WSAVA/media/PDF_old/jsap_0.pdf. Published 2014. Accessed September 2019.

Suggested Reading

Reiter AJ, Gracis M. *BSAVA Manual of Canine and Feline Dentistry and Oral Surgery*. Quedgeley, UK: BSAVA; 2018.

IMAGE GALLERY ▸ CONTINUED FROM PAGE 21

References

1. Tekin HG, Sigsgaard V, Zachariae C, Hare RK, Arendrup MC, Saunte DML. Would you like to purchase a rodent with dermatophytes? *Mycoses*. 2019;62(7):584-587.
2. Hill WA, Brown JP. Zoonoses of rabbits and rodents. *Vet Clin North Am Exot Anim Pract*. 2011;14(3):519-531, vii.
3. Pignon C, Mayer J. Zoonoses of ferrets, hedgehogs, and sugar gliders. *Vet Clin North Am Exot Anim Pract*. 2011;14(3):533-549, vii.

PRACTICE HOTLINE

The latest in products and services

Veterinary Loyalty Program Performance Study Results

Vet2Pet (**vet2pet.com**) recently conducted a study that compared data from loyalty program members 12 months after program enrollment with the data from 12 months pre-enrollment. The data from 201 clinics with 548,516 program members were collected and analyzed by **VetSuccess** (**vetsuccess.com**). Findings indicate that loyalty program members visited the clinic 5 times more often and increased their spending as compared with pre-enrollment visits and spending. Clinics that implemented a rewards program experienced an average annual revenue increase of $100,011, which is a 6.4% increase in total clinic revenue. For the full report, visit bit.ly/36orTbF.—*Press Release 11/2019*

Study on Aging

The **University of Washington School of Medicine** (**uwmedicine.org**) and the **Texas A&M University College of Veterinary Medicine & Biomedical Sciences** (**vetmed.tamu.edu**) have announced the launch of the **Dog Aging Project** (**dogagingproject.org**). This 10-year study will measure changes in dogs' physical function as they age. Genome sequencing data from 10,000 dogs will be integrated with health measurements and behavioral traits. Scientists will look for molecular predictors of disease, physical decline, and longevity. The trial will also assess the effects of rapamycin on cognition, heart function, health span, and life span in ≈500 middle-aged dogs. Dogs included in the study will be of various ages, sizes, and breeds, represent both sexes and intact status, and may be healthy or have chronic illness.—*Press Release 11/2019*

Fund to Help Move Life Science Ideas to the Market

BioNexus KC (**bionexuskc.org**) has announced the creation of a seed capital fund focused on helping animal and human health companies bring new technologies to the market. Many innovative products tend to fail to transfer from the laboratory to the market because the company cannot bridge the gap between academic funding and commercialization. This investment fund will help with that transition. An advisory committee will evaluate opportunities and provide companies with guidance on research and development activities.—*Press Release 12/2019*

WSAVA & World Animal Protection Partner to Improve the Lives of Dogs

WSAVA (**wsava.org**) and **World Animal Protection** (**worldanimalprotection.org.uk**) have engaged in a new Memorandum of Understanding in which they will work together to raise awareness regarding animal welfare issues and promote animal welfare education worldwide. The agreement will prioritize the importance of the veterinary role in humane dog population management and in the control and eradication of rabies. WSAVA members will have access to campaign resources from **Life's Better with Dogs** (**worldanimalprotection.org/lifes-better-dogs**) and the **Animals in Disasters** (**worldanimalprotection.org/our-work/animals-disasters**) PrepVet veterinary training course. World Animal Protection will promote WSAVA's Global Guidelines for Companion Animal Welfare.—*Press Release 1/2020*

SEND INFORMATION FOR PRACTICE HOTLINE TO editor@cliniciansbrief.com

NexGard®
(afoxolaner) Chewables

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

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

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

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

Dosing Schedule:

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

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

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

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

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

Contraindications:
There are no known contraindications for the use of NexGard.

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

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

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

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

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

Table 1: Dogs With Adverse Reactions.

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

[1]Number of dogs in the afoxolaner treatment group with the identified abnormality.
[2]Number of dogs in the control group with the identified abnormality.

In the US field study, one dog with a history of seizures experienced a seizure on the same day after receiving the first dose and on the same day after receiving the second dose of NexGard. This dog experienced a third seizure one week after receiving the third dose. The dog remained enrolled and completed the study. Another dog with a history of seizures had a seizure 19 days after the third dose of NexGard. The dog remained enrolled and completed the study. A third dog with a history of seizures received NexGard and experienced no seizures throughout the study.

Post-Approval Experience (July 2018):
The following adverse events are based on post-approval adverse drug experience reporting. Not all adverse events are reported to FDA/CVM. It is not always possible to reliably estimate the adverse event frequency or establish a causal relationship to product exposure using these data.

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

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

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

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

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

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

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

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

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

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

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

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

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

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References

Bischoff K, Rumbeiha WK. Pet food recalls and pet food contaminants in small animals: an update. *Vet Clin North Am Small Anim Pract*. 2018;48(6):917-931.

Ferguson DC, Hoenig M. Endocrine system. In: Latimer KS, ed. *Duncan and Prasse's Veterinary Laboratory Medicine: Clinical Pathology*. 5th ed. Ames, IA: Wiley-Blackwell; 2011:299-301.

Finch NC. Hypercalcaemia in cats: the complexities of calcium regulation and associated clinical challenges. *J Feline Med Surg*. 2016;18(5):387-399.

Koch SN, Torres SMF, Plumb DC. Dimethyl sulfoxide. In: Koch SN, Torres SMF, Plumb DC. *Canine and Feline Dermatology Drug Handbook*. Ames, IA: Wiley-Blackwell; 2012:365-367.

LeBlanc CJ, Echandi RL, Moore RR, Souza C, Grooters AM. Hypercalcemia associated with gastric pythiosis in a dog. *Vet Clin Pathol*. 2008;37(1):115-120.

Linde KJ, Kelleher TR, Perry JA. Biological implant-associated granulomatous inflammation resulting in secondary hypercalcemia and azotemia in a dog. *Clin Case Rep*. 2018;6(9):1801-1806.

Messinger JS, Windham WR, Ward CR. Ionized hypercalcemia in dogs: a retrospective study of 109 cases (1998-2003). *J Vet Intern Med*. 2009;23(3):514-519.

Schenck PA, Chew DJ, Nagode LA, Rosol TJ. Disorders of calcium: hypercalcemia and hypocalcemia. In: DiBartola SP, ed. *Fluid, Electrolyte, and Acid-Base Disorders in Small Animal Practice*. 4th ed. St Louis, MO: Elsevier Saunders; 2012:136-156.

Stern JA, Chew DJ, Schissler JR, Green EM. Cutaneous and systemic blastomycosis, hypercalcemia, and excess synthesis of calcitriol in a domestic shorthair cat. *J Am Anim Hosp Assoc*. 2011;47(6):e116-e120.

Stiver S, Laukkanen C, Luong R. Suspected hypercalcemia of benignancy associated with canine vaginal leiomyoma. *J Am Anim Hosp Assoc*. 2019;55(2):e55205.

Stockham SL, Scott MA. Calcium, phosphorus, magnesium, and their regulatory hormones. In: Stockham SL, Scott MA, eds. *Fundamentals of Veterinary Clinical Pathology*. 2nd ed. Ames, IA: Blackwell Publishing; 2008:598-602.

Van den broek DH, Chang YM, Elliott J, Jepson RE. Chronic kidney disease in cats and the risk of total hypercalcemia. *J Vet Intern Med*. 2017;31(2):465-475.

Verin R, Cian F, Stewart J, et al. Canine clitoral carcinoma: a clinical, cytologic, histopathologic, immunohistochemical, and ultrastructural study. *Vet Pathol*. 2018;55(4):501-509.

Yuki M, Nitta M, Omachi T. Parathyroid hormone-related protein-induced hypercalcemia due to osteosarcoma in a cat. *Vet Clin Pathol*. 2015;44(1):141-144.

QUIZ CORNER

QUIZ YOURSELF

on this issue's features

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1 **TOP 5** **PAGE 10**

When gonadectomized at a young age, large- and giant-breed dogs may be at increased risk for morbidity and mortality from all of the following except _____.

A. Joint disease
B. Neoplasia
C. Unwanted litters
D. Urinary incontinence

2 **IMAGE GALLERY** **PAGE 18**

Which of the following small mammals can be fractious; have thin skin and long, piercing incisors; and should be restrained using towels and thick protective gloves?

A. Ferrets
B. Chinchillas
C. Guinea pigs
D. Sugar gliders

3 **CONSULT THE EXPERTS** **PAGE 26**

Which of the following may help improve pet owner compliance with pet medication regimens?

A. Simplifying dose regimens
B. Building a relationship between the veterinary team and the owner
C. Using tools such as checklists
D. All of the above

4 **IMAGE GALLERY** **PAGE 57**

_____ is/are benign but may cause vision obstruction and abnormal behavior patterns (eg, fly-biting, headshaking).

A. Uveal cysts
B. Iris atrophy
C. Persistent pupillary membranes
D. Iris stromal hemorrhage

5 **WSAVA DENTAL SERIES** **PAGE 61**

Which of the following may be a consequence of an uncomplicated crown fracture?

A. Pain
B. Bacterial pulp infection
C. Faster plaque and calculus accumulation
D. All of the above

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

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What one little chew can do

[1]Data on file.

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IMPORTANT SAFETY INFORMATION: NexGard is for use in dogs only. The most frequently reported adverse reactions include vomiting, pruritus, lethargy, diarrhea and lack of appetite. The safe use of **NexGard** in pregnant, breeding, or lactating dogs has not been evaluated. Use with caution in dogs with a history of seizures or neurologic disorders. For more information, see the full prescribing information or visit www.NexGardClinic.com.

See page 70 for product information summary.