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Editorial  Éditorial

Brachycephalic dogs — time for action
Chiens brachycéphales — il est temps d’agir

A little over 4 years ago, Fraser Hale, a veterinary dentist, wrote an opinion piece in this journal entitled “Stop brachycephalism, now!” (1). The article focused on the dental problems encountered by brachycephalic dogs and argued that breeding of these animals was a serious animal welfare issue that needed to be addressed. The author anticipated that his article would “stimulate some lively, possibly acrimonious response.” That never happened. This journal received no comments about the article.

Three developments made me decide to write on this topic. One was information that brachycephalic breeds are gaining popularity as pets (2,3). Another was a report that in response to calls from veterinarians and members of the public, the British Veterinary Association (BVA) had recently adopted a strong position on the breeding of dogs with extreme conformation (2). The 3rd was a recent US report on the numerous health issues of brachycephalic dogs (3).

Several writers have discussed the health problems of brachycephalic dogs. The dental problems and constant respiratory distress associated with these breeds are probably the best known. A recent analysis of disease prevalence in over 1.27 million dogs over 9 years (based on pet health insurance claims) identified several other conditions that occurred at exceptional frequency in brachycephalic breeds (3). The study did not involve the conditions well known to be a part of the Brachycephalic Obstructive Airway Syndrome (BOAS) (stenotic nares, elongated soft palate, tracheal hypoplasia, everted laryngeal saccules). The aim of the analysis was to determine whether brachycephalic dogs had health issues other than those of BOAS.

The protruding eyes of brachycephalic dogs were found to cause a higher prevalence of ocular disease than in other breeds: corneal ulcers were 3 to 4 times more frequent in brachycephalic dogs and there was a significant increase in the prevalence of conjunctivitis and corneal trauma (3). Excessive skin folds in

Il y a un peu plus de quatre ans, Fraser Hale, un dentiste vétérinaire, a rédigé un article d’opinion dans cette revue qui s’intitulait «Stop brachycéphalism, now!» (Mettons fin au brachycéphalisme dès maintenant!) (1). L’article portait sur les problèmes dentaires dont souffrent les chiens brachycéphales et il faisait valoir que l’élevage de ces animaux constituait un sérieux problème de bien-être animal qui devait être abordé. L’auteur s’attendait à ce que son article «suscite une réponse animée et potentiellement acrimonieuse», ce qui ne s’est jamais produit, car cette revue n’a jamais reçu de commentaires à propos de l’article.

Trois faits nouveaux m’ont décidé à écrire sur ce sujet. Le premier était des informations indiquant que les races brachycéphales gagnent en popularité en tant qu’animaux de compagnie (2,3). Un autre était un rapport à l’effet que la British Veterinary Association (BVA), en réponse à des appels lancés par des vétérinaires et des membres du public, avait récemment adopté une position s’opposant fermement à l’élevage de chiens avec une conformation extrême (2). Le troisième était un rapport récent des États-Unis sur les nombreux problèmes de santé des chiens brachycéphales (3).

Plusieurs auteurs ont discuté des problèmes de santé des chiens brachycéphales. Les problèmes dentaires et la détresse respiratoire constante associées à ces races sont probablement les mieux connus. Une analyse récente de la prévalence des maladies chez plus de 1,27 million de chiens sur une période de neuf ans (basée sur les réclamations d’assurance maladie pour animaux de compagnie) a identifié plusieurs autres affections qui s’étaient produites à une fréquence exceptionnelle (3). L’étude ne portait pas sur les affections qui sont reconnues comme faisant partie du syndrome brachycéphale d’obstruction des voies respiratoires (narines pincées, palais mou allongé, hypoplasie trachéale, sacs laryngés évasés). Le but de l’analyse consistait à déterminer si les chiens brachycéphales avaient des problèmes de santé autres que le syndrome brachycéphale.
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some brachycephalic breeds resulted in increased rates of skin disease. Other conditions that were found at higher frequency include heat intolerance, digestive disorders, urinary tract infection, dental disease, pneumonia, and intervertebral disk disease (3).

The question of the increasing popularity of brachycephalic breeds in spite of their heightened health risk bears looking into. It is suggested that these dogs are considered “cute” and several prominent celebrities own such dogs. At the same time, veterinarians, with few exceptions (1,2) have not been speaking out about the welfare issues (many of the dogs are in constant respiratory distress and have to contend with the wide array of problems inflicted on them by their breeding). A British veterinarian recently wrote about the problems with brachycephalic dogs and the reasons veterinarians seem to be unwilling to discuss the issue (4). He/she argued that veterinarians are concerned that speaking up on this topic is likely to result in a loss of clients. In fact, the author would not identify him- or herself and wrote anonymously. Given this concern, it is important that professional veterinary organizations take up the challenge of seeing what can be done.

The BVA recognizes the need for the profession to play a leading role and to involve all stakeholders including veterinarians, dog breeders, kennel clubs, and prospective dog owners. The BVA and the British Small Animal Veterinary Association (BSAVA) both recommend against the use for breeding of animals with extreme conformation that negatively impacts their welfare and health (2). The BVA is also suggesting revision of breed standards to place limits on features such as shortness of the muzzle, and to investigate approaches such as outcrossing in order to relieve the unnecessary suffering of dogs such as the English bulldog.

The CVMA’s Position Statement on dog breeding is that “The CVMA opposes the selective breeding of dogs resulting in changes in body form, function or temperament that are detrimental to the health and quality of life of the dog.” Recently, the American Veterinary Medical Association (AVMA) adopted a similar position (5). These are sound positions and a good base for action involving education of the public and working with breeders, kennel clubs, and humane societies to address the health and welfare concerns.

Interestingly, the AVMA’s Animal Welfare Committee had recommended that companion animals with inherited features that adversely affect their welfare and health should not be bred and had included brachycephalic syndrome among a number of inherited conditions in this category. This was opposed by a number of breed organizations, leading to a final statement in which the mention of specific conditions was omitted.

The public needs to be educated about these dogs, which are doomed to a lifetime of poor health and suffering. Veterinarians can be enormously helpful in advising prospective owners to do pre-purchase research and to consider the welfare issues associated with brachycephalic dogs. Veterinary professional organizations in Canada and the US can follow the British lead and take an active role in finding solutions to the problem.

Carlton Gyles

On a constaté que les yeux protubérants des chiens brachycéphales causaient une prévalence supérieure de maladie oculaire par rapport aux autres races : les ulcères cornéens étaient de 3 ou 4 fois plus fréquents chez les chiens brachycéphales et il y avait une hausse importante de la prévalence de la conjonctivite et des traumatismes cornéens (3). Des lambeaux de peau excessifs chez certaines races brachycéphales se sont traduits par des taux accrus de maladies de la peau. D’autres affections ont été observées à une fréquence supérieure, dont l’intolérance à la chaleur, les troubles digestifs, les infections des voies urinaires, les maladies dentaires, la pneumonie et les maladies des disques intervertébraux (3).

La question de la popularité grandissante des races brachycéphales malgré leurs risques de santé accrus mérite d’être étudiée. On suggère que ces chiens sont considérés comme étant «mignons» et plusieurs célébrités en vue possèdent de tels chiens. Parallèlement, les vétérinaires, à quelques exceptions près (1,2), ne se sont pas prononcés contre les enjeux de bien-être (beaucoup des chiens souffrent d’une détresse respiratoire constante et doivent vivre avec un vaste éventail de problèmes qui leur sont infligés en raison de leur élevage). Un vétérinaire britannique a récemment écrit à propos des problèmes des chiens brachycéphales et des raisons pour lesquelles les vétérinaires ne semblent pas disposés à discuter de la question (4). Il/elle a fait valoir que les vétérinaires s’inquiètent probablement du fait qu’ils pourraient perdre des clients s’ils abordent le sujet. En fait, l’auteur ne voulait pas s’identifier et a écrit sous le couvert de l’anonymat. Compte tenu de cette préoccupation, il est important que les organisations vétérinaires professionnelles relèvent le défi d’envisager les mesures éventuelles à prendre.

La BVA reconnait le besoin pour la profession de jouer un rôle de premier plan et d’inviter la participation de tous les intervenants, y compris les vétérinaires, les éleveurs de chiens, les clubs canins et les futurs propriétaires de chiens. La BVA et la British Small Animal Veterinary Association (BSAVA) déconseillent tous deux le recours à l’élevage d’animaux avec une conformation extrême qui affecte négativement leur bien-être et leur santé (2). La BVA suggère aussi la révision des standards des races afin d’établir des limites pour les caractéristiques comme un museau court et d’examiner des approches comme l’accouplement croisé afin de soulager les souffrances inutiles des chiens comme le bouledogue anglais.

L’énoncé de position de l’ACMV sur l’élevage des chiens stipule que : «L’ACMV s’oppose à l’accouplement sélectif des chiens pour produire des changements au niveau du corps, de la fonction ou du tempérament qui sont néfastes pour la santé et la qualité de vie du chien». Récemment, l’American Veterinary Medical Association (AVMA) a adopté un énoncé de position semblable (5). Il s’agit d’énoncés de position équilibrés et d’un bon point de départ pour des activités axées sur la sensibilisation du public et le travail avec les éleveurs, les clubs canins et les sociétés de protection des animaux afin d’aborder les préoccupations en matière de santé et de bien-être.

Fait intéressant, le Comité sur le bien-être animal de l’AVMA avait recommandé que les animaux de compagnie ayant des caractéristiques héréditaires qui affectent négativement leur bien-être et leur santé ne devraient pas être accouplés et il avait inclus...
specifiquement le syndrome brachycéphale parmi les affections héréditaires dans cette catégorie. Plusieurs organisations d’élevage s’étaient opposées à cette prise de position, ce qui avait donné lieu à la publication d’une version finale de l’énoncé où l’on omettait la mention d’affections spécifiques.

Le public doit être sensibilisé à propos de ces chiens, qui sont condamnés à une vie en mauvaise santé et affligée de souffrances. Les vétérinaires peuvent être d’un secours immense pour conseiller aux futurs propriétaires d’effectuer une recherche avant l’achat et de considérer les enjeux de bien-être associés aux chiens brachycéphales. Les organisations professionnelles vétérinaires au Canada et aux États-Unis peuvent suivre l’exemple des Britanniques et jouer un rôle actif pour trouver des solutions au problème.

Carlton Gyles

References
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Ethical question of the month — August 2017

Veterinarians work at provincial sales barns in Ontario to oversee animal health. One of their responsibilities is to euthanize animals that are deemed unfit for sale. A large proportion of cattle to be euthanized at sales barns are cull cows in transit to slaughter that are deemed unfit for transport. Veterinarians, livestock caretakers, and the general public understand the rationale for these cases of humane euthanasia.

Young bull calves are another class of livestock that come to sales barns and are euthanized by veterinarians. These calves are intended to be sold to local veal or beef producers. However, if calves appear sick on sale day they are left unsold. At the end of the sale day the sales barn veterinarian is asked to euthanize them. These calves have a reasonable chance of responding to treatment if given time and nursing care. However sales barns are not designed for this purpose and owners don't want calves returned to the farm. The same veterinarian who euthanizes cull cows in good conscience is reluctant to euthanize calves he/she believes have a good chance for recovery. Is there an ethically sound basis for such a distinction?


Responses to the case presented are welcome. Please limit your reply to approximately 50 words and forward along with your name and address to: Ethical Choices, c/o Dr. Tim Blackwell, 6486 E. Garafraxa, Townline, Belwood, Ontario N0B 1J0; telephone: (519) 846-3413; fax: (519) 846-8178; e-mail: tim.e.blackwell@gmail.com

Suggested ethical questions of the month are also welcome! All ethical questions or scenarios in the ethics column are based on actual events, which are changed, including names, locations, species, etc., to protect the confidentiality of the parties involved.

Les réponses au cas présenté sont les bienvenues. Veuillez limiter votre réponse à environ 50 mots et nous la faire parvenir par la poste avec vos nom et adresse à l’adresse suivante: Choix déontologiques, a/s du D’ Tim Blackwell, 6486, E. Garafraxa, Townline, Belwood (Ontario) N0B 1J0; téléphone : (519) 846-3413; télécopieur : (519) 846-8178; courriel : tim.e.blackwell@gmail.com

Les propositions de questions déontologiques sont toujours bienvenues! Toutes les questions et situations présentées dans cette chronique s’inspirent d’événements réels dont nous modifions certains éléments, comme les noms, les endroits ou les espèces, pour protéger l’anonymat des personnes en cause.
Ethical question of the month — May 2017

The use of animals for testing new pharmaceutical products that may prove effective in the treatment or prevention of serious human diseases is considered acceptable by a large proportion of Canadians, as well as citizens of many other countries. This is in contrast to the use of animals for testing the safety of cosmetics. Testing of cosmetics in animals is banned in all 27 countries in the European Union but is still performed in Canada. Is there an ethical basis for the continued testing of beauty products on animals in Canada? Can a veterinarian in good conscience work in laboratories performing this type of testing?

Question de déontologie du mois — Mai 2017

L'utilisation des animaux pour les essais de nouveaux produits pharmaceutiques qui pourraient s'avérer efficaces dans le traitement ou la prévention des maladies humaines graves est considérée acceptable par une grande proportion de Canadiens ainsi que par les citoyens de beaucoup d'autres pays. Cette situation contraste avec l'utilisation des animaux pour des tests d'innocuité des cosmétiques. Les tests de cosmétiques sur les animaux sont interdits dans les 27 pays de l'Union européenne, mais ils sont toujours réalisés au Canada. Existe-t-il des fondements éthiques pour poursuivre les tests des produits de beauté sur les animaux au Canada? Un médecin vétérinaire peut-il travailler en toute conscience dans des laboratoires qui effectuent ce type de tests?

Is it ethical to work in an animal-based cosmetic toxicology facility? — A comment

The question implies a dichotomy between the necessary and inevitable on one hand (testing of medications), and the “elective” or frivolous (testing of cosmetics) on the other. Rather than condemning the latter and leaving it at that, veterinarians and scientists in general would benefit from questioning the accepted necessity of testing human medications on animal models, with the goal of finding better models and methods.

Veronica G ventsadze, MA, PhD, DVM

An ethicist’s commentary on if it is ethical to work in an animal-based cosmetic toxicology facility

Science is inherently conservative and, in many cases, rightly so. An excellent case in which conservatism was warranted was the infamous instance of two scientists allegedly achieving cold fusion. Their experiments were not replicable, and the research community was wise to be prudently skeptical. On the other hand, conservatism can turn into obdurate dogmatism. A paradigmatic example of this latter situation can be found in the case of ulcers, where conventional wisdom affirmed that ulcers were caused by excessive stomach acid engendered by stress. One researcher amassed considerable evidence that ulcers were caused by Helicobacter pylori. His results were ignored for many years, but eventually he was vindicated and awarded the Nobel Prize.

Probably as a result of its close connection with legal liability for corporations producing beauty products, toxicology in this area has been extremely conservative. Apparently, in order to protect themselves, companies need to perform tests that are traditionally performed, but may not necessarily work. In fact, when I gave the keynote address to the annual meeting of toxicological pathologists, this was a common complaint that I heard from them. Tests such as the Draize test, which involves placing cosmetics in a rabbit’s eye and scoring the resultant lesion, are still being performed, despite the radical disanalogies that obtain between the rabbit’s eye and the human eye.

Similarly, the LD_{50} test, which is known to be a test for acute toxicity, has historically been the test of choice for chronic toxicity, despite the fact that the test does not designate mechanisms of toxicity, and that acute toxicity tells us virtually nothing about chronic toxicity. However, such “well-established” tests were in fact the legal requirements for protecting corporate interests from lawsuits.

Interestingly, there is no legal requirement in the United States that cosmetics be tested on animals. The US Food and Drug Administration (FDA) advises cosmetics manufacturers “to employ whatever testing is appropriate and effective for substantiating the safety of their products,” and notes that the Federal Food, Drug, and Cosmetic Act “does not specifically require the use of animals in testing cosmetics for safety.” There is a massive amount of data showing that in vitro methods of testing are far more reliable than traditional blunt instruments of animal testing. As a result of such data, 27 European countries in the European Union, as well as Israel and India have banned cosmetic testing on animals. Nonetheless, as the case presentation indicates, antiquated animal-based methods are still employed, even though many companies have made their commitment to not testing on animals a mainstay of their marketing. As early as the late 1970’s, readers of Glamour magazine, surely a readership very concerned about cosmetics, indicated in a survey their belief that animal suffering was too big a price to pay for new cosmetics!

During the 1980’s, a colleague of mine gave me a very dramatic example of reactionary scientism in this area. In keeping with the principle of the 3Rs (i.e., replacement, reduction, and refinement), he had developed a method of testing for heavy metal toxicity by using Planaria (flatworms), rather
than mammals. This allowed him to do thousands of tests on his desktop, saving countless animal lives and suffering, and a great deal of money, with comparable accuracy. The toxicological community rejected his work on the grounds that they didn't use flatworms; whereas mainstream journals rejected it on the grounds that they had no interest in toxicology!

Returning to the major question of this case, namely whether a veterinarian can in good conscience continue to work in laboratories utilizing animal testing for cosmetics — this is not a simple question. The answer lies in his or her reasoning for continuing to work there. If, he or she believes that they can change accepted practice, that is good reason to continue to work there. If however, they believe that they are not making any headway, it would be extremely difficult for a morally conscientious person to stay in that job, as one is directly colluding in causing animal suffering for no good purpose, and putting consumers at greater risk by utilizing archaic methods.

Bernard E. Rollin, PhD

Emerging tapeworm infecting dogs and foxes can also prove fatal in humans.

Tapeworm disease in dogs is not a new story, but there is a new species that is an emerging threat to pets and people.

*Echinococcus multilocularis* is a tapeworm that lives in the small intestine of foxes, coyotes, wolves and dogs (definitive hosts) and infects domestic dogs (accidental hosts) via ingestion of small rodents (intermediate hosts). Infected dogs shed tapeworm eggs into the environment and are immediately infectious to people and animals.

Unintentional ingestion of eggs by humans can develop into alveolar echinococcosis (AE) and cause parasitic tumors in the liver, lungs, brain and other organs.1 These cysts grow slowly and may not produce clinical signs in humans for up to 15 years. AE in humans has only a 5% cure rate.2 Left untreated, it is usually fatal.3

### E. multilocularis in Canada

The number of people infected by *E. multilocularis* in Canada is unknown since the disease does not currently have to be reported to Public Health by physicians. However, at least 12 human cases of AE have been identified since 2001. Many more may be currently infected but not yet showing symptoms.4 As *E. multilocularis* becomes a greater public health concern, it is more important than ever to discuss this health risk with pet owners. Intestinal infection with *E. multilocularis* in dogs can be treated with dewormers containing praziquantel, such as Drontal® Plus. If the dog is currently being treated with Advantage Multi®, Droncit® will add tapeworm control to your treatment plan. Droncit® and Drontal® Plus are both approved to treat and control *E. multilocularis* in dogs.

For more information, contact your Bayer Sales Representative, call 1-888-663-5326, or visit AnimalHealth.Bayer.ca.

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2017 CanWest VETERINARY CONFERENCE

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PROGRAM

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COMPANION ANIMAL
- Fire Fast, Hire Slow: How to Source, Screen and Retain – Dr. Odie Marcovici, Recruiting & Professional Relations Director, VCA
- All You Need to Know about Toxicology in your Canine and Feline Pets – Dr. Justine Lee, VETgirl
- Mast Cell Tumors: The Latest and Greatest; Top 10 Recent Advances in Veterinary Oncology; Lymphoma – How Do I treat?; Feline Interactive Oncology Cases – Dr. Philip Bergman, Director of Clinical Studies, VCA
- Which Antibiotic, When and For How Long? – Dr. Jane Sykes, Professor Medicine & Epidemiology, UC Davis – Veterinary Medicine

EQUINE
- In the field, practical medicine with UCVM faculty:
  » Infectious Diseases – Dr. Jean-Yin Tan
  » Laminitis and Colic – Dr. Heidi Banse
  » How to do Blood Transfusions in the Field – Dr. Ashley Whitelaw
  » Horse Not Performing Well: How to Work It Up – Dr. Renaud Leguillette
- Equine Alternative Medicine: Acupuncture, Chinese Medicine, Veterinary Medical Manipulation Techniques and Philosophies – Dr. Vasiliki (Vickie) Harvey, Chi Institute/Integrative Veterinary Institute
- Equine Ophthalmology: “You see what you know” – Dr. Dennis Brooks, University of Florida, College of Veterinary Medicine

FOOD ANIMAL
- No Feet, No Cow! Identifying and Managing Common Foot Ailments in Cattle and Calf Diarrhea - Worst Case Scenario – Dr. Frank Welker, Ohio State University – Department of Veterinary Preventive Medicine
- Pharmacology:
  » NSAIDs in Food Animals, Dr. Merle Olson, Alberta Veterinary Laboratories
  » Mucosal Immune System Development in Food Animal Calves, Dr. Phil Griebel, VIDO – InterVac, Vaccine and Infectious Disease Organization – International Vaccine Centre, University of Saskatchewan
  » Antibiotic Resistance and Stewardship in Food Animals, Dr. Brian Lubbers, Kansas State University
- Response to Animal Health Outbreaks Referred to the UCVM – Dr. Eugene Janzen, University of Calgary, Faculty of Veterinary Medicine
- Newborn Beef Calf Health Management – Dr. Elizabeth Homerosky, Veterinary Agri-Health Services

VETERINARY TEAM
- Hands-Free Veterinary Radiography – Ms. Julia Bitan and Ms. Ashley Jenner, Hands-Free Veterinary Radiography
- JumpStart Boot Camp Workshop – Ms. Terra Shastri, Ontario Veterinary Medical Association
- Growing Leaders in Your Practice – Dr. Wendy Hauser, Peak Veterinary Consulting

VETERINARY TECHNOLOGIST
- Compassionate Closure: End-of-Life Issues for Veterinary Professionals – Dr. Cherie Buisson, Helping Hands Hospice/A Happy Vet
- Predator Attacks on Wildlife – Mr. Mike Ewald, Regional Problem Wildlife Specialist, Fish and Wildlife Enforcement Branch
- Diabetes Mellitus – Let’s Not Sugar Coat It!; Fanconi Syndrome; and Pancreatitis – Ms. Rachel Poulin, Coral Springs Animal Hospital – Department of Internal Medicine

KEYNOTE LUNCHEON
- Public Views of Animal Treatments: Misplaced or Realistic Concerns? – Dr. Ellen Goddard, University of Alberta, Faculty of Agricultural, Life and Environmental Sciences

ABVMA/UCVM WET LABS
FRIDAY, OCTOBER 13
(INSTRUCTED BY UCVM FACILITY)
- Reconstructive Surgery Techniques (half-day lab), Dr. Aylin Atilla
- Clinical Pathology: Urinalysis and Urine Sediment Examinations (half-day lab), Drs. Cathy Wagg and Amy Warren
- Introductory Abdominal Ultrasound (full-day lab), Drs. Soren Boysen and Serge Chalhoub
- Equine Internal Medicine: Examining and Sampling the Horse’s Airway (half-day lab), Drs. Renaud Léguillette and Marie-France Roy
- Equine: How to Provide Advance GI Diagnostics in the Field (half-day lab), Drs. Jean-Yin Tan and Ashley Whitehead

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1. Which of the following is true regarding liver enzymes?
   A. SDH is liver-specific and is a leakage enzyme.
   B. Aspartate aminotransferase (AST) is liver-specific and is a leakage enzyme.
   C. Alkaline phosphatase (ALP) is liver-specific and is an induced enzyme.
   D. Alanine aminotransferase (ALT) is not liver-specific and is an induced enzyme.
   E. AST is not liver-specific and is an induced enzyme.

2. Which of the following statements is most correct concerning endodontic disease in dogs?
   A. The most common cause of endodontic disease in dogs is dental caries.
   B. Radiographic signs of endodontic disease include periapical or apical lysis and large endodontic canals compared to contralateral teeth.
   C. The only successful treatment plan for dogs with endodontic disease is timely extraction of the affected tooth.
   D. Endodontic disease in dogs is caused by demineralization of calcified dental tissues when plaque bacteria use fermentable carbohydrates as a source of energy.

3. A 12-year-old male dog undergoes surgical excision of a perianal gland neoplasm and castration at the same time. Sectioning of the testes — which externally are of normal size — reveals 1 or 2 soft, yellow nodules in each. The most likely diagnosis for these masses is:
   A. Leydig cell neoplasms
   B. Seminomas
   C. Sertoli cell neoplasms
   D. Lipogranulomas
   E. Metastasis of the perianal gland neoplasm
4. A 5-year-old Quarter Horse mare is experiencing agalactia following the birth of a large weak foal. Which of the following forages could be responsible for this problem?
   A. Orchard grass
   B. Perennial ryegrass
   C. Fescue
   D. Alfalfa
   E. Timothy

5. Displaced abomasum may be corrected by blind procedures if which of the following is true?
   A. The displacement is to the right.
   B. The cow is 7 months pregnant.
   C. The cow has metritis.
   D. The cow is standing during the procedure.
   E. Abomasal surgery is in the cow’s history.

(See p. 867 for answers./Voir les réponses à la page 867.)
Annual Awards Ceremony Recognizes CVMA Members for Outstanding Contributions to Veterinary Medicine

For over 30 years, the Canadian Veterinary Medical Association (CVMA) has proudly recognized its members for their exceptional contributions to the veterinary profession, and animal health and welfare. This year was no exception as individuals were honored at the CVMA Awards Ceremony in Charlottetown, Prince Edward Island, which took place during the 2017 CVMA Convention in July.

Dr. David Condon was honored with the CVMA Small Animal Practitioner Award, sponsored by Petsecure Pet Health Insurance, for his compassion and dedication to animals since early childhood. Growing up on a small family farm on Prince Edward Island, Dr. Condon decided at the age of 6 that he wanted to become a veterinarian and he graduated from the Atlantic Veterinary College (AVC) in 1991. After graduation, he worked at a mixed animal practice in Seaforth, Ontario, for 1 year. Being a true Islander, he returned to Prince Edward Island and worked in Montague for the next year. Dr. Condon purchased the Abegweit Animal Hospital in 1993, which moved him away from large animal practice into primarily small animal practice, which he enjoys to this day. He has developed a strong interest in veterinary dentistry and has devoted a significant portion of his time pursuing continuing education in this area.

Depuis plus de 30 ans, l'Association canadienne des médecins vétérinaires (ACMV) reconnaît avec fierté les contributions extraordinaires de ses membres à la profession vétérinaire ainsi qu’à la santé et au bien-être des animaux. Cette année n’a pas fait exception lorsque des personnes ont été honorées durant la Cérémonie annuelle de remise des prix de l’ACMV qui s’est déroulée à Charlottetown, à l’Île-du-Prince-Édouard, durant le congrès 2017 de l’ACMV

Le Prix du praticien des petits animaux de l’ACMV, qui est commandité par Petsecure assurance maladie pour animaux, a été décerné au Dr David Condon pour sa compassion et son dévouement continu envers les animaux depuis sa tendre enfance. Le Dr Condon, qui a grandi dans une petite ferme familiale à l’Île-du-Prince-Édouard, a décidé à l’âge de six ans qu’il désirait devenir vétérinaire et il a obtenu son diplôme de l’Atlantic Veterinary College (AVC) en 1991. Après la fin des études, il a travaillé dans une pratique mixte à Seaforth, en Ontario, pendant un an. Un véritable natif de l’Île-du-Prince-Édouard, il est retourné dans l’île et a travaillé à Montague pendant l’année suivante. Le Dr Condon a ensuite acheté la clinique Abegweit Animal Hospital en 1993, ce qui lui a permis de se concentrer principalement sur la pratique des petits animaux, qu’il aime toujours exercer aujourd’hui. Il a
He was instrumental in the formation of the student chapter of the Foundation for Veterinary Dentistry for AVC students and hosts dental wet labs for students at his clinic and offers lunch lectures on veterinary dentistry at AVC. Dr. Condon travels with the Peter Emily International Veterinary Dental Foundation to provide free veterinary dental care to captive large cats (tiger, lions, etc.). He is a member of the Foundation for Veterinary Dentistry, the CVMA, the PEI Veterinary Medical Association, and the Canadian Veterinary Reserve. He currently serves on the board of directors of his local watershed group and has had past involvement with the PEI Wildlife Federation.

Veterinarian Dr. Anne McDonald was awarded the CVMA Humane Award, sponsored by Merck Animal Health. Dr. McDonald graduated from the Western College of Veterinary Medicine (WCVM) in 1976 and completed a 1-year internship at Texas A&M University in small animal clinics, followed by a 2-year residency in surgery. After leaving Texas, she worked in Red Deer, Alberta, for 6 months, and then returned to Vancouver, British Columbia to work at the Vancouver Animal Emergency Clinic for the next 11 years. Dr. McDonald purchased the Night Owl Bird Hospital in 1990, which has been her focus ever since. Dr. McDonald has been recognized for her tremendous efforts in the treatment of, caring for, and re-homing of almost 600 parrots from the World Parrot Refuge on Vancouver Island after the death of its owner in May 2016. Many of the birds from the Refuge had health issues, with over 100 small and large birds being hospitalized for the first few months.

The Merck Veterinary Award, sponsored by Merck Animal Health, was presented to Dr. Stephen LeBlanc for his work as a professor in the Department of Population Medicine at the Ontario Veterinary College, and as research program director — Animal Production Systems at the University of Guelph. He received a Bachelor of Science (Agriculture) in Animal Science from McGill University in 1992, and a Doctor of Veterinary Medicine (1997) and Doctor of Veterinary Science (2001) from the University of Guelph. After 5 years of private dairy veterinary practice, he joined the faculty at the University of Guelph where he teaches veterinary and agriculture students developed a strong interest for the veterinary dentistry and has dedicated a large part of his time to the development of this field. It has played a crucial role in the formation of the section director of the Foundation for Veterinary Dentistry at the AVC and has organized several laboratory work sessions for veterinary students to apply their knowledge and offer conferences of mixed practice in the field of veterinary dentistry to the AVC. Le D’ Condon voyage avec la Peter Emily International Veterinary Dental Foundation afin d’offrir des soins vétérinaires dentaires gratuits aux grands félidés en captivité (tigres, lions, etc.). Il est membre de la Foundation for Veterinary Dentistry, de l’ACVM, de la PEI Veterinary Medical Association et de la Réserve vétérinaire canadienne. Il est actuellement membre du conseil d’administration de son groupe local de protection du bassin hydrographique et il a déjà œuvré au sein de la PEI Wildlife Federation.

Le Prix humanitaire de l’ACMV, qui est commandité par Merck Santé animale, a été décerné à la vétérinaire D‘ Anne McDonald. La D‘ McDonald a obtenu son diplôme du Western College of Veterinary Medicine (WCVM) en 1976 et a suivi un internat d’un an à l’Université Texas A&M en pratique des petits animaux, suivi d’une résidence de deux ans en chirurgie. Après avoir quitté le Texas, elle a travaillé à Red Deer, en Alberta, pendant six mois et est ensuite retournée à Vancouver, en Colombie-Britannique, pour travailler à la Vancouver Animal Emergency Clinic au cours des onze années suivantes. La D‘ McDonald a acheté la clinique Night Owl Bird Hospital en 1990 et c’est à cet endroit qu’elle consacre toute son énergie depuis ce temps. La D‘ McDonald a été reconnue pour ses efforts exceptionnels pour le traitement, les soins et le repérage d’un nouveau foyer pour près de 600 perroquets du World Parrot Refuge sur l’île de Vancouver après la mort du propriétaire en mai 2016. Bon nombre des oiseaux du refuge avaient des problèmes de santé et près de 100 petits et grands oiseaux ont été hospitalisés au cours des premiers mois.

Le Prix vétérinaire Merck, qui est commandité par Merck Santé animale, a été présenté au D‘ Stephen LeBlanc pour son travail à titre de professeur au Département de médecine de la population à l’Ontario Veterinary College et en tant que directeur du programme de recherche sur les systèmes de production
and provides clinical farm service. He is past-president of the Dairy Cattle Reproduction Council and serves as section editor for the *Journal of Dairy Science*. His research focuses on transition dairy cow metabolic and reproductive health and management, including field validation of precision technologies. With graduate students and collaborators, this work has resulted in over 100 peer-reviewed papers. He has given invited talks in 20 countries.

The *Practice of the Year Award*, sponsored by *Scotiabank*, was presented to the *Mona Campbell Centre for Animal Cancer (MCCAC)* for creating a comprehensive veterinary cancer centre serving central Canada and beyond, while creating unique clinical trial research opportunities for the Ontario Veterinary College (OVC) and the University of Guelph. The Centre offers surgery, radiation, chemotherapy, and investigational therapies in conjunction with clinical trials to diagnose and treat cancer in animals. The MCCAC provides experiential oncology teaching in the Doctor of Veterinary Medicine program and provides postgraduate training for veterinarians seeking further clinical training in oncology in residencies, internships, and for students seeking postgraduate degrees. Clinicians and researchers at the MCCAC continually seek better ways to treat cancer in pets (some of which may translate into helping people with cancer) through clinical trials. The Centre is the only international member of the National Institutes of Health Center for Cancer Research Comparative Oncology Trials Consortium. The clinical caseload has facilitated the creation of the Companion Animal Tumour Sample Bank in the MCCAC, which is a unique resource providing access to clinical specimens from naturally occurring cancers to the scientific research community. Since inception, the veterinarians, students, and staff who serve in the Mona Campbell Centre for Animal Cancer have worked in conjunction with veterinary cancer patients and their families to create an internationally recognized comprehensive veterinary cancer centre with the goal of compassionately treating companion animals with cancer while advancing the understanding of cancer and improving treatment options to benefit both animal and human patients.

Dr. Jeanne Lofstedt, 2017 *CVMA Life Membership* Recipient.

*D* Jeanne Lofstedt, récipiendaire du titre de Membre à vie de l’ACMV 2017.

Dr. Bob Bellamy, 2017 *CVMA President’s Award* Recipient.


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The *Practice of the Year Award*, sponsored by *Scotiabank*, was presented to the *Mona Campbell Centre for Animal Cancer (MCCAC)* for creating a comprehensive veterinary cancer centre serving central Canada and beyond, while creating unique clinical trial research opportunities for the Ontario Veterinary College (OVC) and the University of Guelph. The Centre offers surgery, radiation, chemotherapy, and investigational therapies in conjunction with clinical trials to diagnose and treat cancer in animals. The MCCAC provides experiential oncology teaching in the Doctor of Veterinary Medicine program and provides postgraduate training for veterinarians seeking further clinical training in oncology in residencies, internships, and for students seeking postgraduate degrees. Clinicians and researchers at the MCCAC continually seek better ways to treat cancer in pets (some of which may translate into helping people with cancer) through clinical trials. The Centre is the only international member of the National Institutes of Health Center for Cancer Research Comparative Oncology Trials Consortium. The clinical caseload has facilitated the creation of the Companion Animal Tumour Sample Bank in the MCCAC, which is a unique resource providing access to clinical specimens from naturally occurring cancers to the scientific research community. Since inception, the veterinarians, students, and staff who serve in the Mona Campbell Centre for Animal Cancer have worked in conjunction with veterinary cancer patients and their families to create an internationally recognized comprehensive veterinary cancer centre with the goal of compassionately treating companion animals with cancer while advancing the understanding of cancer and improving treatment options to benefit both animal and human patients.
Dr. Jeanne Lofstedt, a native of Benoni, South Africa, was honored with a Life Membership this year for her significant contributions to the CVMA and the veterinary profession. Summers spent on the sheep and dairy farms of close relatives, the influence of an uncle who was a veterinarian, as well as the opportunity to volunteer at a mixed animal practice during high school inspired Dr. Lofstedt to pursue a career in veterinary medicine. In 1975, she received a Bachelor of Veterinary Science degree with honors from the University of Pretoria in South Africa and was awarded the Sir Arnold Theiler Medal for the student with the highest academic standing overall. After 7 months in a mixed animal practice in Krugersdorp, South Africa, she was accepted into a rotating internship in Large Animal Medicine and Surgery at the Western College of Veterinary Medicine in Saskatoon, Saskatchewan. In 1981, she completed a 3-year residency in Food Animal Medicine and Surgery and received a Master of Science degree in Pathology, both at Iowa State University. She then joined Tufts University as an assistant professor in Large Animal Medicine from 1981 to 1987 and became board certified in Large Animal Internal Medicine in 1987. That same year she moved to Prince Edward Island to assume a faculty position at the Atlantic Veterinary College (AVC) where she is currently professor of Large Animal Medicine in the Department of Health Management. Dr. Lofstedt has held various leadership positions at the AVC and volunteer positions with the CVMA and other veterinary organizations. Among other activities, she served as the associate dean of Academic Affairs at AVC, was a member of the American College of Veterinary Internal Medicine Examination Committee, a member of the Journal of Veterinary Medical Education Editorial Board, a North American Veterinary Licensing Examination item writer, a site visit team member for the American Veterinary Medical Association Council on Education and the CVMA, a member of the CVMA National Issues and Professional Development Committees, and CVMA president from 2002–2003. She has been the scientific program coordinator for the CVMA since 2004.

Dr. Bob Bellamy was awarded the 2017 CVMA President’s Award for his expertise and outstanding dedication to the veterinary profession. Shortly after graduating from the Western College of Veterinary Medicine (WCVM), University of Saskatchewan in 1976, Dr. Bellamy established a mixed animal practice in Moose Jaw, Saskatchewan. A former Saskatchewan Veterinary Medical Association (SVMA) president (2004), he has chaired the SVMA Practice Economic Committee for the past 25 years and served as the chair of the CVMA Business Management Committee until its status was changed to an Advisory Group in 2015. After 40 years in practice, Dr. Bellamy remains passionate about the value veterinary medicine returns to both humans and animals. He established the SVMA’s social media initiative, SaskVets, and remains the project coordinator. The SVMA is proud to boast one of the highest number of followers of any veterinary group in the country with the popularity of SaskVets. Dr. Bellamy, turning a photography hobby into video production, produced a series called “Just Like You” informational videos that focus on client information and are available to any veterinarian. The videos are hosted on the CVMA’s YouTube channel and a variety of Vimeo sites. The goal facilite la création de la Companion Animal Tumour Sample Bank au MCCAC, qui est une ressource unique fournissant l’accès à des spécimens cliniques de cancers naturels pour la collectivité de la recherche scientifique. Depuis sa fondation, les vétérinaires, les étudiants et le personnel qui travaillent au Mona Campbell Centre for Animal Cancer ont oeuvré, de concert avec des patients cancéreux vétérinaires et leurs familles, afin de créer un centre du cancer vétérinaire à services complets qui est reconnu à l’échelle internationale et qui a pour but de traiter les animaux de compagnie atteints du cancer avec compassion tout en faisant progresser la compréhension du cancer et en améliorant les options de traitement pour le bénéfice des patients animaux et humains.


Le Prix du président de l’ACMV 2017 a été décerné au Dr Bob Bellamy pour son expertise et son dévouement exceptionnel envers la profession vétérinaire. Peu de temps après avoir obtenu son diplôme du Western College of Veterinary Medicine (WCVM) de l’Université de la Saskatchewan en 1976, le Dr Bellamy a fondé une pratique mixte à Moose Jaw, en
is to “not only tell clients what is being done, but show them.” Dr. Bellamy is adamant that the veterinary profession retain the privilege to both prescribe and dispense. He coordinated the production of the Saskatchewan Dispensing Manual for Veterinarians, which reviews the relevant federal and provincial legislation regulating veterinary drug sales.

The R.V.L. Walker Award is presented annually to the president of the Students of the CVMA (SCVMA) for his/her work to promote student interests in the Association. This award features 2 recipients — a plaque is presented to the president of the Students of the CVMA and a cash award is made available to the veterinary college where the president is registered to provide financial assistance to a student veterinarian in need. The recipient of this year’s R.V.L. Walker Award plaque is Ms. Elizabeth Hartnett, from the Ontario Veterinary College. Ms. Hartnett decided she wanted to be a veterinarian at the age of 5 and has always been fascinated by the natural world. Growing up in a military family, she lived in several different places — from Germany to Manitoba to Québec — before her family settled in Kingston, Ontario. She completed her undergraduate studies in Environmental Biology at Queen’s University and received a Master in Environmental Studies degree from York University, where she focused on humane education and environmental ethics. For several years, Ms. Hartnett worked in environmental research and policy, while volunteering at the Toronto Wildlife Centre on weekends. Realizing her interests in the environment, public policy, and wildlife health were compatible with a career in veterinary medicine, she decided to finally apply to veterinary school. Ms. Hartnett enjoys being involved at OVC and in the wider community, and loves to practice her clinical skills by volunteering with Community Veterinary Outreach.

Nominations for the 2018 CVMA Awards will open in the fall of 2017. The submission deadline is January 31, 2018. Visit the CVMA website (www.canadianveterinarians.net/about/awards) to learn more.
CVMA Begins Process to Enhance Stewardship of Veterinary Antimicrobial Medications

L’Association canadienne des médecins vétérinaires (ACMV), avec le soutien financier d’Agriculture et Agroalimentaire Canada (AAC) et sous le leadership d’un Groupe consultatif d’experts (GCE) qui est dirigé par le Dr Phil Buote de l’Alberta, a tenu un atelier les 9 et 10 mai 2017 à Ottawa afin d’entamer un projet qui améliorera l’utilisation des antimicrobiens vétérinaires par l’élaboration de lignes directrices qui appuieront une utilisation responsable et prudente des médicaments antimicrobiens chez les animaux.

L’atelier a marqué le début d’un processus pour élaborer des outils pratiques prêts à la mise en œuvre afin d’appuyer les vétérinaires en lien avec l’utilisation prudente des antimicrobiens pour six groupes d’espèces (bovins, bovins laitiers, volaille, porcs, petits ruminants et animaux de compagnie). L’objectif de l’atelier consistait à engager les intervenants et à obtenir leur rétroaction pour la définition des besoins de la boîte à outils future. Le moment de cette initiative est important car on prévoit que la réglementation fédérale visant les médicaments vétérinaires entrera en vigueur en novembre 2017 et en juillet 2019.

Plus de 40 participants provenaient des associations de médecins vétérinaires, des groupes d’espèces et des pratiques, as well as government, industry, and academic stakeholders. Participants collaborated in both mixed groups and species-specific groups to collectively analyze the broader AMU environment and identify key stakeholders; review other initiatives and tools of relevance in Canada and elsewhere; identify the factors that influence how veterinarians in practice make decisions on antimicrobial use; identify key considerations regarding tool formats and testing; and develop recommendations on both project and post-project outputs and outcomes.

Next steps include the establishment of 5 work streams including: antimicrobial stewardship principles and decision
support practices; guidelines for prudent use of antimicrobials; platforms for hosting of tools and templates; sustainability; and communication strategies. A 6th work stream on surveillance is proposed that would be funded through a separate program and build upon work conducted at an AMU Surveillance Workshop held Feb. 28 to Mar. 1 (see editorial in The CVJ’s May 2017 issue). The above work streams will require the EAG and project team over the coming months to revise and finalize the project plan, engage subject matter experts, and initiate activity across all work streams.

How Green is your Veterinary Practice?
Evaluate how your practice measures up with Self-Audit Tool

The Canadian Veterinary Medical Association (CVMA) developed a checklist to help you do a “self-audit” on your practice to evaluate how your practice measures up from an environmental sustainability perspective.

It will help you identify the changes you have made that positively impact the environment, and will also provide new ideas on other initiatives that could be implemented. To access the self-audit tool, visit the website (www.canadianveterinarians.net) and under the Practice & Economics tab the Green Veterinary Practice information can be found under Practice Tools (your CVMA member login will be required).

The CVMA encourages veterinarians to submit their green practice success stories! Send your completed Self-Audit Tool, along with a brief description of how your practice has reduced its environmental footprint; send photos too!

Your practice could be profiled to inspire others to introduce green change in their veterinary hospital. Details can be sent to (communications@cvma-acmv.org).

The CVMA’s Green Veterinary Practice initiative, a collection of eco-friendly resources for veterinary practices, is a web-based resource that offers tips on how to make your veterinary practice more environmentally friendly.

Votre pratique vétérinaire est-elle écoresponsable?
Évaluez le rendement de votre pratique à l’aide de l’outil d’autovérification

L’Association canadienne des médecins vétérinaires (ACMV) a mis au point une liste de contrôle pour vous aider à effectuer une «autovérification» de votre pratique et à évaluer le rendement de votre pratique du point de vue de la durabilité environnementale.

Cet outil vous aidera à identifier les changements que vous avez apportés et qui ont un impact positif sur l’environnement et il vous communiquera de nouvelles idées sur d’autres initiatives qui pourraient être mises en œuvre. Pour accéder à l’outil d’autovérification, visitez le site Web (www.veterinairesau-canada.net) et, sous l’onglet Pratique et finances, vous pourrez trouver les renseignements sur une pratique vétérinaire écoresponsable sous Outils pour la pratique (vous devrez ouvrir une session).

L’ACMV encourage les vétérinaires à soumettre leurs histoires de réussite en ligne sur les pratiques écoresponsables! Envoyez votre outil d’autovérification rempli, de même qu’une brève description de la façon dont votre pratique a réduit son empreinte écologique. Vous pouvez aussi envoyer des photos!

Votre pratique pourrait être le sujet d’un article afin d’inspirer vos collègues à introduire des changements écologiques dans leur clinique vétérinaire. Vous pouvez acheminer les détails à (communications@cvma-acmv.org).

L’initiative d’une Pratique vétérinaire écoresponsable de l’ACMV, une collection de ressources écologiques pour les pratiques vétérinaires, est une ressource Web qui offre des conseils sur la façon d’améliorer l’empreinte écologique de votre pratique vétérinaire.
Diagnostic Report can show if your staff strategy is working by while others thrive with higher staff per doctor. The Practice see success with a slower pace and less staff per veterinarian, There is no "right way" to staff a veterinary hospital. Some Staff metrics to account for higher than average diet sales. hit revenue targets, and can expect to see higher visits per client and track production targets. For example, practices that have years, client retention. Client benchmarks can be used to develop for practices that provide consistent client data for 2 consecutive years. Sales contribute less than the benchmark, they have work to do. Revenue mix is another important practice benchmark to measure and manage again to track improvement. The CVMA Practice Diagnostic Report is the quintessential tool to help veterinarians measure and manage their practice.

Revenue metrics
In isolation, annual or monthly revenue has limited applicability. Comparing one month to the same month of the previous year shows growth, but without benchmarks, veterinarians don't know how revenue growth compares to their colleagues. For example, you could have 5% growth in revenues, which you think is great, until you find out the average practice in the province grew by 10% over the same time. Similarly, your annual revenues could have topped one million dollars last year but when you find out the average hospital earned $1.5 million with the same number of veterinarians, you realize there is room for improvement.

Revenue mix is another important practice benchmark to measure their effort's effectiveness to promote a specific area. For example, if a hospital prides itself on nutrition, they could expect diet sales contributing a higher than average revenue share. If, according to their Practice Diagnostic Report, their diet sales contribute less than the benchmark, they have work to do.

Client metrics
The Practice Diagnostic Report provides benchmarks on clients per veterinarian, revenue per client, client visits per year and, for practices that provide consistent client data for 2 consecutive years, client retention. Client benchmarks can be used to develop and track production targets. For example, practices that have fewer clients per veterinarian need higher revenue per client to hit revenue targets, and can expect to see higher visits per client to account for higher than average diet sales.

Staff metrics
There is no “right way” to staff a veterinary hospital. Some see success with a slower pace and less staff per veterinarian, while others thrive with higher staff per doctor. The Practice Diagnostic Report can show if your staff strategy is working by

**Rapport diagnostique de la pratique de l’ACMV : une gestion factuelle**

Les progrès de la technologie et de la communication ont permis de réaliser des essais de laboratoire de pointe dans toutes les cliniques vétérinaires de l’Amérique du Nord. La disponibilité et l’abordabilité de l’équipement de laboratoire à l’interne et des laboratoires spécialisés ont contribué à l’uniformisation des règles du jeu entre les petites pratiques comportant un seul médecin et les grandes cliniques spécialisées. Le résultat est une population d’animaux en santé grâce à la médecine factuelle.

Le Rapport diagnostique de la pratique de l’ACMV offre cette possibilité pour les affaires financières. Une disponibilité accrue des mesures de rendement financier fournies dans le Rapport diagnostique de la pratique aide à améliorer les pratiques individuelles ainsi que la santé financière de la profession vétérinaire. Les membres de l’ACMV qui remplissent le Sondage auprès des propriétaires de pratique ont accès à une analyse comparative gratuite pour le chiffre d’affaires, les dépenses, les heures travaillées, les honoraires et les employés. Le rapport calcule les paramètres financiers et les compare à ceux des cliniques moyennes et les plus performantes dans la province. Pour la première fois en 2016, le Rapport diagnostique de la pratique a comparé les tendances annuelles pour les cliniques individuelles qui ont soumis des données pendant deux années consécutives.

Les gestionnaires accomplis savent que la gestion factuelle est essentielle au succès financier de la pratique : il faut mesurer, gérer et mesurer de nouveau pour effectuer un suivi des améliorations. Le Rapport diagnostique pour la pratique de l’ACMV est l’outil par excellence pour aider les vétérinaires à mesurer et à gérer leur pratique.

Données sur le chiffre d’affaires
Examinés en vase clos, les chiffres d’affaires annuels ou mensuels ont une utilité limitée. La comparaison d’un mois au même mois de l’année précédente indique de la croissance mais, sans les données comparatives, les vétérinaires ne savent pas comment la croissance de leur chiffre d’affaire se compare à celle de leurs collègues. Par exemple, vous pourriez avoir une croissance de 5 % du chiffre d’affaires, et vous pensez que cela est excellent, jusqu’à ce que vous appreniez que la pratique moyenne dans la province a connu une croissance de 10 % pendant la même période. Parallèlement, votre chiffre d’affaires annuel a pu atteindre un million de dollars l’an dernier, mais quand vous apprenez que la clinique moyenne a connu un chiffre d’affaires de 1,5 million $ avec le même nombre de vétérinaires, vous réalisez qu’il y a encore place à l’amélioration.

La répartition du chiffre d’affaires est une autre mesure comparative importante pour mesurer l’efficacité de leurs efforts visant à promouvoir un domaine particulier. Par exemple, si une clinique est fière de ses activités de nutrition, elle pourrait s’attendre à ce que ses ventes d’aliments contribuent à une part du chiffre d’affaires qui est supérieure à la moyenne. Si, selon le Rapport diagnostique de la pratique, les ventes d’aliments contribuent à une part inférieure à celle des données comparatives du rendement, les cliniques ont alors du travail à faire.
examining the staff numbers per doctor as well staff wages as a gross revenue percentage. If staff wages as a gross revenue percentage are higher than average, the staff strategy may not be working and the practice owner can look to the staff per doctor benchmarks to fine tune or develop an entirely new staff strategy.

**Expenses as a percent of gross revenue**

The Practice Diagnostic Report’s cornerstone is the expense analysis. Expenses as a gross percentage are compared to the average and previous year, highlighting areas where there may be potential cost savings by reining in expenses. Many practice owners reported they cancelled yellow pages, reduced office supply costs, and started managing inventory better once they saw their expenses were higher than average.

**Fees**

One of the most important revenue determinants is veterinary fees. The Practice Diagnostic Report shows veterinarians how their fees compare to the average and their province’s fee guide. A year over year comparison is also provided with an analysis showing how incomes could improve with fee increases.

**Practice Value Estimate**

Based on information from the Practice Owners Economic Survey and financial statements, the Practice Value Estimate provides a practice value estimate based on cash flow. Presented as a gross revenue percentage, the Practice Value Estimate incorporates revenue, expenses and veterinary production. Some veterinarians see the figure as an annual financial grade. If the Practice Value Estimate has gone up then the practice is in better shape than the previous year.

**Help line**

The Practice Owners Economic Survey is designed for the “average” veterinarian. If you have questions about the survey or need help getting your practice management software information, contact Darren Osborne or Terra Shastri at the Ontario Veterinary Medical Association (OVMA) to get help from experts: call 800-670-1702 or fax 877-482-5941 or e-mail (dosborne@ovma.org) (tshastri@ovma.org).

The CVMA Practice Owners Economic Survey, the Individual Practice Diagnostic Report and the Practice Value Estimate are free for CVMA members.

(by Darren Osborne, MA)

**Données sur les clients**

Le Rapport diagnostique de la pratique fournit des mesures comparatives sur les clients par vétérinaire, les recettes par client, les visites des clients par année et, pour les pratiques qui fournissent des données constantes sur les clients pendant deux années consécutives, la rétention des clients. Les mesures comparatives sur les clients peuvent être utilisées pour établir et effectuer le suivi des cibles de production. Par exemple, les pratiques qui ont moins de clients par vétérinaire ont besoin de produire des recettes supérieures par client pour atteindre leurs cibles de recettes et elles peuvent s’attendre à voir un nombre supérieur de visites par client pour expliquer des ventes d’aliments supérieures à la moyenne.

**Données sur les employés**

Il n’y a pas de «bonne façon» de déterminer la dotation d’une clinique vétérinaire. Certaines cliniques obtiennent du succès avec un rythme plus ralenti et moins d’employés par vétérinaire, tandis que d’autres prospèrent avec un nombre élevé d’employés par médecin. Le Rapport diagnostique de la pratique peut montrer si la stratégie de personnel fonctionne en examinant le nombre d’employés par médecin ainsi que les salaires des employés en tant que pourcentage du chiffre d’affaires brut. Si les salaires des employés en tant que pourcentage du chiffre d’affaires brut sont supérieurs à la moyenne, la stratégie des ressources humaines peut ne pas fonctionner et le propriétaire de pratique peut consulter les données comparatives sur les employés par médecin pour ajuster sa stratégie ou en développer une nouvelle.

**Dépenses en tant que pourcentage du chiffre d’affaires brut**

Le pilier du Rapport diagnostique de la pratique est l’analyse des dépenses. Les dépenses en tant que pourcentage brut sont comparées à la moyenne et à l’année précédente en soulignant les domaines où il pourrait y avoir des économies potentielles en réduisant les dépenses. Beaucoup de propriétaires de pratique ont signalé qu’ils ont annulé les pages jaunes, réduit le coût des fournitures de bureau et commencé à mieux gérer leur inventaire une fois qu’ils ont constaté que leurs dépenses étaient supérieures à la moyenne.

**Honoraires**

Les honoraires vétérinaires représentent l’un des facteurs déterminants du chiffre d’affaires les plus importants. Le Rapport diagnostique pour la pratique montre aux vétérinaires comment leurs honoraires se comparant à la moyenne et à leur guide tarifaire provincial. Une comparaison entre les années est aussi fournie avec une analyse indiquant comment les bénéfices pourraient progresser avec une hausse des tarifs.

**Estimation de la valeur d’une pratique**

L’Estimation de la valeur de la pratique, qui se fonde sur les renseignements contenus dans le Sondage économique auprès des propriétaires de pratique et les états financiers, fournit une estimation de la valeur de la pratique qui se base sur l’encaisse. Présentée sous forme de pourcentage du chiffre d’affaires brut, l’Estimation de la valeur de la pratique inclut les recettes, les dépenses et la production vétérinaire. Certains vétérinaires considèrent ce chiffre comme une note financière annuelle. Si l’Estimation de la valeur de la pratique a augmenté, alors la pratique se trouve dans une meilleure situation que l’année précédente.

**Ligne d’assistance**

Le Sondage économique auprès des propriétaires de pratique est conçu pour le vétérinaire «moyen». Si vous avez des questions à propos du sondage ou si vous avez besoin d’aide pour obtenir les données dans le logiciel de gestion de la pratique, veuillez contacter Darren Osborne ou Terra Shastri à l’Ontario Veterinary Medical Association (OVMA) pour obtenir l’aide des experts; composez le 800-670-1702 ou envoyez une télécopie au 877-482-5941 ou un courriel (dosborne@ovma.org) (tshastri@ovma.org).

Le Sondage économique de l’ACMV auprès des propriétaires de pratique, le Rapport diagnostique pour la pratique individuelle et l’Estimation de la valeur de la pratique sont offerts gratuitement aux membres de l’ACMV.

(par Darren Osborne, M.A.)
The topic of wellness in veterinary medicine is important and must be considered a priority. The Canadian Veterinary Medical Association (CVMA) has been looking at ways to support Canadian veterinarians on their wellness journey and contribute to their success in achieving a work-life balance. One new CVMA Health and Wellness initiative is the CVMA-GoodLife Fitness Corporate Discount Program for CVMA members.

Why it’s important to have regular physical activity:
• Weight control
• Prevention or management of health conditions and diseases
• Mood and mental health improvement
• Increasing energy
• Sleep improvement

Why it’s important for you and your employees to be active and healthy:
• 60% of Canadians are overweight and 23% are clinically obese. These factors could inhibit work performance and contribute to increased employer costs related to absenteeism, benefit costs and short- and long-term disability leaves.
• Work-related stress — the number one health risk affecting Canadian employees — is linked to poor health.

In the veterinary profession, stress and the danger of long-term exhaustion are significant, and the risk of suicide among veterinarians is disturbing. The long hours, heavy workload, and poor work-life balance threaten the health and well-being of all veterinary professionals, whether you’re a student, faculty, practice owner, practice manager or associate veterinarian.

A healthier, happier life is one step away. The CVMA corporate membership can save you up to 40% off regular individual membership rates. To view the GoodLife flyer or FAQs, visit the CVMA website’s Member Benefits and Services section (www.canadianveterinarians.net/membership/benefits-services).

To join now, visit (corporate.goodlifefitness.com), have your CVMA Membership ID Number ready and select Canadian Veterinary Medical Association (ACMV). If you do not have or forget your ID number or have additional questions, please contact the CVMA (admin@cvma-acmv.org).

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L’ACMV et GoodLife Fitness forment un partenariat afin d’offrir des abonnements à tarif réduit aux membres

Le sujet du bien-être en médecine vétérinaire est important et nous devons assurer que cet enjeu demeure une priorité. L’Association canadienne des médecins vétérinaires (ACMV) a examiné des façons d’appuyer les médecins vétérinaires canadiens dans leur parcours de bien-être ainsi que de contribuer à leur succès afin qu’ils parviennent à atteindre un équilibre travail-vie. Une nouvelle initiative de l’ACMV en matière de santé et de bien-être est le Programme de rabais d’entreprise de l’ACMV-GoodLife à l’intention des membres de l’ACMV.

Pourtant il est important de s’adonner régulièrement à de l’activité physique :
• Contrôle du poids
• Prévention ou gestion des troubles de santé et des maladies
• Amélioration de l’humeur et de la santé mentale
• Regain d’énergie
• Sommeil de meilleure qualité

Pourtant il est important que vous et vos employés demeuriez actifs et en santé :
• 60 % des Canadiens souffrent d’embonpoint et 23 % sont cliniquement obèses. Ces facteurs pourraient entraver leur rendement au travail et contribuer à une hausse des coûts de l’employeur à cause de l’absentéisme, des coûts des avantages sociaux ainsi que des congés d’invalidité de courte et de longue durée.
• Le stress relié au travail — le risque numéro un pour la santé qui affecte tous les employés canadiens — est associé à une mauvaise santé.

Dans la profession vétérinaire, le stress et le danger d’épuisement à long terme sont importants et le risque de suicide parmi les vétérinaires est troublant. Les longues heures, la lourde charge de travail et un mauvais équilibre travail-vie menacent la santé et le bien-être de tous les professionnels vétérinaires, que vous soyez étudiant, professeur, propriétaire de pratique, gestionnaire de pratique ou vétérinaire salarié.

Une vie plus heureuse et en meilleure santé se trouve à votre portée. L’abonnement d’entreprise de l’ACMV peut vous économiser jusqu’à 40 % sur le prix de l’abonnement individuel régulier. Pour visualiser le feuillet GoodLife ou la FAQ, visitez la section des Avantages et services aux membres du site Web de l’ACMV (veterinairesaucanada.net/membership/benefits-services).

Pour vous abonner maintenant, visitez (corporate.goodlifefitness.com), ayez votre numéro de membre de l’ACMV à portée de la main et choisissez Association canadienne des médecins vétérinaires (ACMV). Si vous n’avez pas votre numéro de membre ou si vous l’avez oublié ou pour toute autre question, veuillez contacter l’ACMV (admin@cvma-acmv.org).
Animal Welfare: Safeguarding the Five Animal Freedoms

Animal Health Week 2017

The Canadian Veterinary Medical Association (CVMA) is reminding animal owners about the 5 basic freedoms animals require to survive and thrive: adequate shelter, proper nutrition, appropriate veterinary care, proper socialization, and the ability to exhibit normal behaviors.

Under the campaign slogan, “Animal Welfare: Safeguarding the Five Animal Freedoms,” Animal Health Week, a national public awareness campaign running from October 1 to 7, 2017, highlights the fundamental elements animal owners are required to provide the animal(s) in their care to ensure them healthy and happy lives.

Dr. Troy Bourque, 2016–17 CVMA president, explains why his clinic is celebrating this year’s Animal Health Week.

“We are becoming more acutely aware as a society that it is our responsibility as guardians to provide the animals in our care with the necessities they require to live healthy and happy lives. It is our duty to fulfill each of the Five Animal Freedoms and provide pets and other animals in our care with these elements that not only allow them to survive, but to thrive. We’re celebrating Animal Health Week at our clinic because we recognize the importance of instilling this sense of responsibility in our clients.”

We invite you to share your celebrations on Facebook or Twitter using the hashtag #AnimalHealthWeek.

Our generous supporters

Generous support of the 2017 Animal Health Week campaign is provided by Principal Plus Sponsor, Boehringer Ingelheim, Principal Sponsor, Petsecure, and Program Sponsors, Elanco and iFinance Canada (Petcard). This month, we invite you to learn more about our Program Sponsor, Elanco.

A message from Elanco

As an animal health company, Elanco is dedicated to safeguarding animal welfare and respect for animals around the world. Our products and services empower veterinarians, pet owners, and farmers to achieve good welfare outcomes for animals — from pain relief, to disease prevention, to efficient use of resources. We believe animal welfare is integral to the sustainability of our global communities, which means looking towards an animal welfare future that is better for our communities, our animals, and our planet.

Animal Welfare: Safeguarding the Five Animal Freedoms

Protégez les cinq libertés afin d’assurer le bien-être animal

Semaine de la vie animale 2017

L’Association canadienne des médecins vétérinaires (ACMV) désire rappeler aux propriétaires d’animaux les cinq libertés animales fondamentales dont ils ont besoin pour survivre et s’épanouir : un hébergement adéquat, une alimentation appropriée, des soins vétérinaires appropriés, une socialisation appropriée et la capacité de manifester un comportement normal.

Sous la bannière du slogan de la campagne «Protégez les cinq libertés afin d’assurer le bien-être animal», la Semaine de la vie animale, une campagne nationale de sensibilisation du public qui se déroulera du 1er au 7 octobre 2017, soulignera les éléments fondamentaux que les propriétaires doivent fournir aux animaux confiés à leurs soins afin d’assurer qu’ils mènent une vie heureuse et en santé.

Le Dr Troy Bourque, président 2016–2017 de l’ACMV, explique pourquoi sa clinique célèbre la Semaine de la vie animale de cette année.

«Nous devons de plus en plus nous rendre compte que notre responsabilité en tant que gardiens d’animaux est de fournir aux animaux confiés à nos soins ce dont ils ont besoin pour vivre heureux et en santé. C’est notre devoir de respecter chacune des cinq libertés animales et de fournir aux animaux de compagnie et aux autres animaux confiés à nos soins tous les éléments dont ils ont besoin non seulement pour survivre, mais pour s’épanouir. Nous célébrons la Semaine de la vie animale à notre clinique parce que nous reconnaissions l’importance d’inculquer ce sentiment de responsabilité à nos clients.»

Nous vous invitons à partager vos célébrations sur Facebook ou Twitter en utilisant le mot-clé #AnimalHealthWeek.

Nos généreux commanditaires

La campagne 2017 de la Semaine de la vie animale est généreusement appuyée par le commanditaire principal plus, Boehringer Ingelheim, le commanditaire principal, Petsecure, et les commanditaires de programme, Elanco et iFinance Canada (Petcard). Ce mois-ci, nous vous invitons à en apprendre davantage à propos de notre commanditaire de programme, Elanco.

Un message d’Elanco

En tant que compagnie de santé animale, Elanco se consacre à la préservation du bien-être animal et du respect pour les animaux.
at the whole picture of animal care, not just the role that our products play. Respect for animals means taking responsibility for our role in safeguarding their welfare and supporting food and companionship that enriches lives.

We are empowering stakeholders worldwide with a science-based approach to understanding and practicing good animal care that provides positive outcomes for animals. Elanco applies the principles of animal welfare from product development through support for the responsible use of animal health products and services — for all animals. To improve or sustain good animal care today, and set the stage for future generations, we are actively collaborating with diverse stakeholders to listen, learn, and share knowledge so we can work together to focus on housing, feeding, health, and appropriate behaviors that sustain or improve animal welfare outcomes and the critical relationship to sustainability.

Ultimately, how we contribute to the Five Freedoms for animals is less about us, and more about empowering others in their efforts to provide good animal care and innovative solutions that support animals having a life worth living. We say thank you to all the veterinarians, pet owners, and farmers who are responsible for animal welfare outcomes every day.

For more information about Elanco or the products that we sell, visit (elanco.ca).

CVMA’s Group Insurance Program Provides Protection and Saves You Money

Le Programme d’assurance de groupe de l’ACMV fournit de la protection et vous permet de réaliser des économies

The Canadian Veterinary Medical Association’s Group Insurance Program offers CVMA members exclusive, specialized group insurance solutions including liability/malpractice, commercial, employee benefits and life and disability. The CVMA Program also offers members exclusive rates, discounts and benefits on home, automobile, recreational vehicle and travel insurance.

Western Financial Insurance Group Solutions

CVMA’s endorsed partner, Western Financial Group Insurance Solutions (WFGIS) delivers policies tailored to every CVMA member’s unique needs. Since its inception in 2005, the CVMA Insurance Program has provided stable pricing and coverage flexibility to over 1800 practices.
The best time to review your insurance is 2 to 3 months prior to the policy renewal date. During the year, WFGIS may contact non-participating CVMA members, identifying themselves as CVMA's insurance partner, to determine your policy renewal date and ensure sufficient time to review with you your insurance needs and coverage options.

WFGIS requires practice information to develop coverage proposals and may have questions about the physical property, operations, sales, claims history and current insurance situation, including the existing commercial policy or coverage booklets, employee data and a recent employee group benefits invoice. This information ensures the coverage offered is tailored to the practice's specific needs and is comparable or superior to your current insurance policy. To honor the guaranteed 10% reduction for equivalent coverage, WFGIS may review your current policy to provide a comparable coverage quote.

The coverage proposal and insurance plan comparison illustrates the differences between your expiring policy and the Program coverage offered and is reviewed with you to explain the coverage and address your questions or concerns. WFGIS ensures a seamless transition to the CVMA Program by arranging proper documentation for all parties.

**The Personal Home and Auto Insurance**

CVMA’s partner, The Personal Insurance Company’s Home and Auto Group Insurance, offers CVMA members personalized coverage, discounts and quality service with no-hassle claims and fast convenient service from knowledgeable agents. Your spouse and dependents can also benefit from your group offer, including:

- Save 5% on your premium all year when driving with 4 winter tires during the winter months.
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**Assurance habitation et auto**

La Personnelle

Le partenaire de l’ACMV, l’assurance habitation et auto de groupe La Personnelle, offre aux membres de l’ACMV une couverture personnalisée, des rabais ainsi qu’un service de qualité avec un service de réclamations sans tracas et rapide offert par des agents expérimentés. Votre conjoint et vos personnes à charge peuvent aussi profiter de votre offre de groupe, y compris les avantages suivants:

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- Souscrivez une police et vous recevrez un rabais de bienvenue pouvant atteindre 7 %.
- Les étudiants au collège ou à l’université qui sont à charge et âgés de moins de 25 ans réalisent des économies.
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• Save on your home insurance when you also insure your car.
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Now, The Personal Insurance Co. made insurance even easier with Alert: real time smartphone notifications if water leakage is detected. With Alert, you can relax knowing you will be notified before water leakage worsens. Alert is exclusive to all insured with The Personal and the water and freeze detector are free! The Personal App also features online services to manage your policies or file a claim anytime, anywhere.

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To get a quote, download the App (promo.thepersonal.com/mobile-app) or call the Personal Insurance Co. at 1-866-860-CVMA (2862).

The CVMA Insurance Program was designed for veterinarians and is overseen by the CVMA for the protection of its members. For additional information, call 1-866-860-2862 or visit (cvmainsurance.com).

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The Role of CVMA Position Statements

Le rôle des énoncés de position de l’ACMV

One important way that Canadian veterinarians can support the national veterinary community and help veterinarians to lead the stewardship of animal welfare in Canada, is to contribute to the development and presentation of strong, unified positions on important matters of concern to Canadian veterinarians.

The CVMA National Issues Committee (NIC) and Animal Welfare Committee (AWC) continually review and monitor veterinary and animal welfare issues. On important issues, and where concerns exist based on ethics and/or scientific evidence, the committees may develop Position Statements and present them to the CVMA Council for approval and adoption.

CVMA Position Statements are used by CVMA members, the public, and the media. When specific issues arise, media outlets may contact the CVMA seeking current Canadian veterinary

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Si vous cherchez de l'assurance voyage ou de l'assurance maladie pour animaux de compagnie ou si vous avez besoin d'assurance pour votre véhicule récréatif, parlez à un représentant de La Personnelle, car la compagnie offre aussi cette couverture.

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Le Programme d’assurance de l’ACMV a été conçu pour les vétérinaires et est supervisé par l’ACMV pour la protection de ses membres. Pour obtenir des renseignements additionnels, composez le 1-866-860-2862 ou visitez (cvmainsurance.com).

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De façon importante dont les vétérinaires canadiens peuvent appuyer la collectivité vétérinaire nationale et aider les vétérinaires à orienter la gestion du bien-être animal au Canada est de contribuer à l'élaboration et à la présentation de positions solides et solidaires sur des questions importantes pour les vétérinaires canadiens.

Le Comité sur les enjeux nationaux (CEN) et le Comité sur le bien-être animal (CBA) de l’ACMV examinent et surveillent de manière continue les enjeux vétérinaires et les questions liées au bien-être animal. Les comités pourront se fonder sur des enjeux importants et les situations où il existe des preuves déontologiques et/ou scientifiques pour élaborer des énoncés de position et les présenter au Conseil de l’ACMV aux fins d’approbation et d’adoption.

Les énoncés de position sont utilisés par les membres de l’ACMV, le public et les médias. Lorsque des questions spécifiques sont soulevées, les médias pourront contacter l’ACMV afin d’obtenir les points de vue des vétérinaires canadiens. Les exemples incluent des enjeux sur les usines à chiots, la violence envers les animaux, l’euthanasie, le recours et la résistance aux antimicrobiens et les lois sur les chiens méchants. Les énoncés de position servent de fondement aux déclarations de l’ACMV aux médias et ils sont fournis aux porte-parole de l’ACMV lorsqu’ils leur demandent de représenter l’ACMV auprès des médias afin qu’ils possèdent des notes factuelles et conformes à l’opinion solidaire de tous les vétérinaires canadiens.
Les énoncés de position de l’ACMV, qui abordent des enjeux vétérinaires nationaux et des questions liées au bien-être animal, ont pour but d’orienter la profession et d’informer le public sur le point de vue de la collectivité vétérinaire. Les positions visent à présenter des points de vue «avant-gardistes» sur des questions sociétales et vétérinaires canadiennes et internationales. Cependant, on reconnaît et encourage les organismes de réglementation à en tenir compte lors de la mise à jour ou de la modification des règlements vétérinaires (p. ex., chirurgie esthétique, dentisterie vétérinaire).

Le but du CBA consiste à appuyer l’ACMV en étant un défenseur solide, visible, actif et avant-gardiste du bien-être animal. Le CBA examine surtout des preuves scientifiques qui serviront de fondements factuels pour les positions sur le bien-être animal. Le CBA considère aussi les enjeux éthiques, philosophiques et moraux entourant les questions liées au bien-être animal.

Le CEN a pour but d’appuyer l’ACMV afin d’aider les vétérinaires canadiens à identifier, à évaluer et à aborder les enjeux nationaux et de défendre leurs intérêts sur des questions portant sur la santé animale, la santé publique, la santé des écosystèmes et la salubrité des aliments. Le CEN se penche principalement sur les preuves scientifiques servant de données probantes aux positions.

Lorsque le CBA ou le CEN identifie des enjeux exigeant une position, ils sont présentés au Conseil de l’ACMV aux fins d’approbation. Le Conseil peut aussi identifier un enjeu et demander au CBA ou au CEN d’élaborer une position. Les membres de l’ACMV sont invités à formuler des commentaires sur l’ébauche des énoncés de position afin que le CEN ou le CBA puissent tenir compte de la rétroaction dans la version finale. On transmet aussi l’ébauche aux organismes de réglementation provinciaux de la médecine vétérinaire pour qu’ils la fassent circuler et ils sont invités à fournir des commentaires. Les ébauches finales des positions sont examinées par le Conseil et les positions approuvées sont affichées sur le site Web de l’ACMV.
H. parasuis, the etiological agent of Glässer’s disease, is one of the most important bacterial pathogens of swine (1). It usually causes polyserositis, but infection may also result in arthritis, meningitis, and septicemia (sudden death) (1). Haemophilus parasuis also contributes to porcine respiratory disease complex, one of the leading causes of mortality in grower-finisher pigs worldwide (1). Although considered as a primary cause of pneumonia (1), strains isolated from lungs have been described as being different from those recovered from systemic infections (2). In addition, low or non-virulent strains have also been isolated from healthy lungs and bronchoalveolar fluid (1,3).

Serotyping of this pathogen is important for decisions on vaccination strategy to prevent future outbreaks as bacterins which are usually used induce mainly serotype-specific immunity. The original serotyping scheme, based on reactions between antisera and surface antigens, classifies H. parasuis into 15 serotypes. Originally, gel immunodiffusion assay (GID) was used to describe these 15 serotypes and to perform epidemiological studies. However, the arrival of the indirect hemagglutination test (IHA) allowed identification of the serotype of many strains that had been non-typable using the GID. An isolate would usually be reported as non-typable if there was no observable antigen-antibody reaction (4). Also, when several antisera reacted with the same isolate, it would be considered as non-typable or it would be assigned the serotype indicated by the strongest agglutination reaction (4), depending on the laboratory in which the serotyping was carried out. Using these methods, distribution of serotypes in various countries showed that, in general, the prevalent serotypes were (the order may vary depending on the country): 2, 5, 4, 7, 13, and 14 (5). More specifically, the sole serotyping report from Canada (Québec) more than 10 y ago showed that serotypes 4 (27%), 5 (15%), 13 (14%), and 7 (12%) were the most prevalent (6). In the same study, serotypes 4 (25%), 12 (23%), and 5 (15%) were shown to be mainly present among US strains (6). During the last few years, a relatively high percentage of untypable and/or cross-reacting strains have been reported elsewhere (5) as well as in isolates from Quebec (Laboratoire d’expertise en pathologie animale du Québec, LEPAQ, unpublished data). Based on the concept that the capsule locus is responsible for the phenotype of the capsule, a single-step multiplex polymerase chain reaction
(mPCR) was developed (4). Fourteen out of 15 serotypes could be individually identified, as no gene could be identified to differentiate between serovars 5 and 12, as shown by whole-genome sequences of these serovars (7). In the present study, strains recovered from diseased pigs in Quebec were serotyped using IHA and a modified version of the mPCR test.

A total of 90 isolates of *H. parasuis* recovered from diseased pigs in Quebec were included in this study: 25 isolates were recovered from systemic diseases (polyserositis, meningitis, arthritis), 62 isolates were obtained from lungs of animals with respiratory disease, and 3 isolates had no accompanying information. The IHA test was conducted as previously described (6). The mPCR test was a modification of a previously published protocol (4). In our hands, results from the original single-step mPCR were sometimes difficult to interpret because many bands were closely clustered. Hence, the test was modified in a 3-step mPCR to clearly differentiate the serotypes. Briefly, a loopful of bacteria was suspended in 100 μL of Instagene Matrix (Bio-Rad, Mississauga, Ontario) and manufacturer’s instructions were followed. A 3-μL volume of Instagene extract for each sample was added to each of the 3 mPCR mixtures, which included 12.5 μL of Multiplex PCR kit (2X master mix; Qiagen, Toronto, Ontario), 2.5 μL of the primer mix (PM1), PM2, or PM3, and 8 μL of UltraPure H₂O. The primer mixes consisted of reverse and forward primers that target the following genes:

- PM1: *funB, glyC, weIP, funQ, funAB*, and HPS_219690793;
- PM2: *wzx, funV, gldP, funL*, and HPS_219690793; and

The mPCR mixtures were heated at 95°C for 15 min, followed by 30 cycles of 94°C for 30 s, 58°C for 90 s, 72°C for 90 s, and a final extension at 72°C for 10 min. Expected results for each serotype are shown in Figure 1.

Serotyping results for both tests are shown in Figure 2. Of the 53 isolates that could be serotyped by the IHA test, only 3 gave a result that was different from that with the mPCR (94.3% agreement). A high concordance for typable isolates by both techniques has previously been described (4). However, 37.8% of isolates in this study were untypable by IHA, but all of these could be serotyped by mPCR. A drastic reduction in untypable isolates by using PCR has been recently reported (4,5). More than half of serotype 7 isolates (52.9%) could not be originally serotyped by IHA; the remaining isolates belonged to serotypes 2 (17.6%), 5/12 (17.6%), and 3, 6, 8, and 13 (2.9% each serotype). Failure in serotyping of these strains by IHA may be due to factors such as a lower sensitivity of the serological test or lack of phenotypic expression of the capsule (4).

Using the mPCR technique, serotypes 7 and 5/12 (22.2% each) were the most common serotypes found, followed by serotypes 4 (15.6%) and 13 (11.1%). Although this is not a prevalence study, it is interesting to note that these 4 serotypes are the same that were most commonly detected in the previous study which also included strains from Quebec (6). Serotypes 2 (7.8%), 1, 3, and 9 (5.6% each one) were also detected. Serotypes 10, 11, and 15 were not found.

The site of isolation may also have some importance, as isolates cultured from systemic diseases survived serum killing and phagocytosis and might be considered as being more virulent than those recovered from the lungs (4). The serotype distribution of strains isolated from systemic and respiratory disease is shown in Figure 3. Serotypes 5/12, 7, and 2 (in decreasing order) were most frequently detected among strains recovered from systemic disease, whereas serotypes 7 and 13, followed by serotypes 4 and 5/12 were frequently identified among respiratory strains. Interestingly, all serotype 13 strains originated from lungs. However, more studies are needed to establish a possible relationship between the serotype and type of infection (systemic versus respiratory). It would also be interesting to conduct the mPCR serotyping on isolates recovered from healthy pigs.

In conclusion, the modified mPCR is a reliable method for serotyping of *H. parasuis*. As multiple infections of the same individual and within herds can occur (2), a highly sensitive test (such as the mPCR) may identify additional isolates that contribute to disease in animals that are not commonly investigated. Indeed, and using the mPCR, we have already observed that more than one serotype may be present in the same sample (unpublished observations). Therefore, the molecular serotyping assay used herein represents a significant improvement in the tools available to characterize *H. parasuis* isolates.
Acknowledgments

We thank all personnel from the Laboratoire d’expertise en pathologie animale du Québec (LEPAQ) for providing the isolates and performing the IHA tests. This study was funded by CDEVQ-MAPAQ.

References

Agreement among undergraduate and graduate veterinary students and veterinary anesthesiologists on pain assessment in cats and dogs: A preliminary study

Graeme M. Doodnaught, Javier Benito, Beatriz P. Monteiro, Guy Beauchamp, Stefania C. Grasso, Paulo V. Steagall

Abstract — This study investigated agreement among undergraduate and graduate veterinary students and veterinary anesthesiologists on video pain assessment at the University of Montreal. Pain assessment in dogs and cats appeared to be affected by gender, previous experience, and degree of training despite a small population of observers.

Résumé — Accord entre étudiants de premier cycle, diplômés en médecine vétérinaire et anesthésistes pour l’évaluation de la douleur chez les chats et les chiens : étude préliminaire. Cette étude a évalué l’accord entre les étudiants de premier cycle, les étudiants diplômés en médecine vétérinaire et les anesthésiologistes vétérinaires pour l’évaluation de la douleur sur vidéo, à l’Université de Montréal. L’évaluation de la douleur chez les chiens et les chats était influencée par le sexe, l’expérience antérieure et le niveau de formation, malgré une population d’observateurs limitée.

Introduction

Effective pain management can only be achieved and maintained when pain is assessed accurately and reliably. The guidelines for recognition and assessment of pain from the World Small Animal Veterinary Association (WSAVA) Global Pain Council note that there is a disparity between the occurrence and the successful management of pain, despite advances in the area. The inability to accurately diagnose pain, limited availability of analgesics, and limitations in clinical understanding remain the most important causes (1). Pain assessment has been shown to be influenced by several factors including gender, cultural differences, and training experience (2).

The aim of this preliminary study was to investigate the agreement among undergraduate and graduate veterinary students and veterinary anesthesiologists on pain assessment in canine and feline patients. The authors hypothesized that undergraduate third-year veterinary students would score pain in dogs and cats similarly to graduate students and board-certified anesthesiologists.

Materials and methods

This preliminary investigation was conducted immediately after a week-long course (6 h of teaching divided in 3 blocks of 2 h) on pathophysiology, assessment, and treatment of pain presented by one of the anesthesiologists (PS) to third-year veterinary students at the University of Montreal. Lectures were given as part of course DMV3132 — “Veterinary Anesthesia, Analgesia, and Resuscitation.”

Participants and study groups

A total of 93 undergraduate third-year veterinary students (student group, SG) were invited by e-mail to participate. Participation was anonymous and voluntary, and the results had no impact on final grades. Three graduate students [2 individuals enrolled in a 3-year residency training program approved by the American College of Veterinary Anesthesia and Analgesia (ACVAA) and 1 PhD student studying the pharmacology of pain; graduate students group, GG] and 2 diplomates of the ACVAA (anesthesiologists group, AG) were also included.

Departments of Clinical Sciences (Doodnaught, Benito, Grasso, Steagall), Biomedical Sciences (Monteiro), and Associate Dean Office for Research and Graduate Studies (Beauchamp), Faculty of Veterinary Medicine, University of Montreal, 3200 Rue Sicotte, Saint-Hyacinthe, Quebec J2S 2M2.

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Presented in part at the Association of Veterinary Anaesthetists Spring Meeting, Lyon, France, April 2016.

Dr. Monteiro is a recipient of the Vanier Canada Graduate Scholarship.

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Study design and performance
The post-training survey model used was designed as a preliminary, exploratory, prospective study. The vice-dean of student affairs at the University of Montreal approved the study. Approval from the animal ethics committee of the University of Montreal was not required since live animals were not included.

Questionnaire
Participants completed an anonymous questionnaire before video analysis. The questionnaire, composed in French, consisted of items to determine the participant’s age, gender, previous work experience (health professional, veterinary technician, veterinarian, and/or previous work in a veterinary clinic) and previous pain experience. The latter was investigated by asking the following questions (Yes/No answer): “Have you ever had surgery while under general anesthesia?” and “Have you ever taken analgesics for a chronic painful condition?”

Videos
Four videos of approximately 5 min each were presented in the same order. The content of the videos included 2 domestic female shorthaired cats (cats 1 and 2) in the postoperative period following ovariohysterectomy (available online at www.animalpain.com.br, test videos numbers 4 and 7), 1 male Doberman dog with suspected prostatic disease (dog 1) and 1 female Dogue de Bordeaux following exploratory celiotomy (dog 2). Before each video, participants were informed about the patient’s signalment (age, gender, and breed), as well as medical condition (dog 1) or type of surgery performed (dog 2, cats 1 and 2). However, they were blinded to any analgesic treatment and were not allowed to discuss the cases.

Pain scales
The pain assessment of the video cases was performed individually using ordinal validated instruments, 2 for each cat, and 1 for each dog. Pain in cats was evaluated using the French version of the UNESP-Botucatu multidimensional composite pain scale (MCPS) (3) and the short-form of the Glasgow composite pain scale (GCMP-SF) (4). Pain in dogs was evaluated using the French version of the Glasgow composite pain scale short-form (GCMP-SF) (5). These instruments require both static and dynamic behavioral evaluations. After watching each video and completing the scales, participants were asked if they would administer rescue analgesia to the animal: “Should the animal on the video receive rescue analgesia?” (Dichotomous answer, Yes/No).

Statistical analysis
Statistical analysis was conducted using unequal variances t-tests (P ≤ 0.05) for investigating differences among the undergraduate students group (SG), for gender, previous work experience (e.g., health professional, veterinary technician, veterinarian, previous clinical work), and previous pain experience (e.g., if they were under surgery previously, if they were treated with analgesics anytime). Comparisons among the different groups (SG, GG, AG) were investigated for age and for the pain scores recorded for the various videos assessed. Data were compared with the group (SG, GG, AG) as a between-subject factor. The unequal variances in the different groups were also taken into account using the Tukey-Kramer post-hoc test (P ≤ 0.05). For the analysis of the question, “Should the animal in the video receive rescue analgesia treatment?” responses among groups were compared using an exact Chi-squared test. The GG and AG groups were combined for the Chi-squared analysis due to the limited number of respondents in these groups. A P-value ≤ 0.05 was considered to be statistically significant. Standard software was used to carry out statistical analyses (SAS, version 9.3, SAS Institute, Cary, North Carolina, USA).

Results
Mean ± standard deviation of students’ age was 23.8 ± 8.5 y. Student demographics are presented in Table 1. Fifty-six (60%) students participated and 8 (14%) completed all sections of the questionnaire and pain assessment. With respect to pain evaluations, response rate to the MCPS and canine GCMP-SF were at least 77% (n = 43), case-specific response rates are shown in Table 2.

Female participants (n = 47) recorded lower pain scores for cat 1 (P = 0.01) and higher scores for dog 2 (P = 0.04) compared with male participants in SG using the GCMP-SF. Previous work experience in veterinary practice or healthcare was associated with significantly decreased pain scoring for dog 2 (P = 0.02). Undergraduate students did not score pain of significant difference with respect to their previous painful experiences (Table 2). Additionally, no significant differences for age were found when the SG was compared with GG and AG. Pain scores were only different between groups for dog 2, in which SG scored significantly higher compared with GG (P = 0.01) and AG (P = 0.01).

Undergraduate students were significantly more likely to administer rescue analgesia for dog 2 (P = 0.01) compared with the combined GG and AG. No significant differences were detected for the other video assessments.

Discussion
This study compared the agreement among undergraduate students and graduate veterinary students and veterinary
anesthesiologists on pain assessment in cats and dogs. Results showed that following an introductory course, differences on pain assessment in cats and dogs by veterinary students might be affected by gender and previous experience. Despite using validated instruments, veterinary students scored pain differently for dog 2 compared with graduate students and anesthesiologists.

A better appreciation of pain management has been attributed to previous experience in a survey with Canadian pet owners (6). The pain assessments for “dog 2” showed the most inconsistencies not only within SG but also in the comparisons with GG/AG. The dog was filmed in the early postoperative period and was showing signs of sedation and residual anesthesia. These conditions (9). Historically, female veterinary practitioners have been more likely to assess pain and administer analgesics in the acute setting (10,11). In addition, at least in Canada, there was a trend favoring increased pain recognition and analgesic administration with younger veterinarians (more recent graduates). This was substantiated in a follow-up study in 2001 (12).

<table>
<thead>
<tr>
<th>Video case</th>
<th>Cat 1</th>
<th>Cat 2</th>
<th>Dog 1</th>
<th>Dog 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain scale</td>
<td>UNESP-MCPS</td>
<td>GCPS feline</td>
<td>UNESP-MCPS</td>
<td>GCPS feline</td>
</tr>
<tr>
<td>QUESTION 1: Have you ever had an operation under general anesthesia?</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Number of total answers (N)</td>
<td>45</td>
<td>15</td>
<td>44</td>
<td>13</td>
</tr>
<tr>
<td>No</td>
<td></td>
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<td></td>
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<tr>
<td>n</td>
<td>29</td>
<td>10</td>
<td>31</td>
<td>9</td>
</tr>
<tr>
<td>mean (± SEM)</td>
<td>18.8 (± 0.4)</td>
<td>10.3 (± 1.8)</td>
<td>6.6 (± 0.7)</td>
<td>4.7 (± 1.1)</td>
</tr>
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<td></td>
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<tr>
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<td>7.3 (± 1.3)</td>
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</tr>
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<tr>
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<td>4.0 (± 1.4)</td>
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<td>—</td>
<td>P = 0.11</td>
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</table>

UNESP — multidimensional composite pain scale (MCPS); Glasgow composite pain scale (GCPS); SF — Short form; SEM — standard error of the mean.

Gender differences were seen on a case-specific basis in the present study; for example, male participants provided higher pain scores for “cat 1” than did their female counterparts, and vice versa for “dog 2.” Interestingly, no difference was seen using the MCPS for cat 1, possibly because most individuals completed the MCPS and often left the GCMP-SF blank. Regardless, the feline MCPS scale was simply more robust in this comparison among the students. Further investigation into gender differences and pain instrument validity for veterinary students is warranted.

The current literature on pain education in veterinary medical curricula has generally shown improved appreciation, understanding, and treatment of pain following both didactic and “hands-on” approaches to teaching (7,8,13). As this is an initial investigation and internal audit on the subject in our institution, follow-up investigation should focus on specific teaching methods and determine strengths and weaknesses, both student-perceived and clinical outcome-driven.

There are several limitations in the current study that should be addressed. Small group sizes may have led to type II error within the study, potentially excluding any differences attributable to age or personal pain experiences, or even between groups (SG versus GG and AG) that may exist. Beyond this, the study was entirely based on video assessment. The instruments provided (MCPS and GCMP-SF) both require patient interaction. The absence of tactile and dynamic interaction with the animal may influence students’ perceptions about pain. It would be of interest to investigate how the students’ first anesthesia course itself may have affected the scores, if at all. Participation was optional; possibly creating an artificial selection bias in which students with greater interest in pain were more likely
to participate. Finally, the study involved only one academic veterinary institution in which courses are taught in French. It is not clear how language, veterinary curricula, and cultural differences would have changed these results.

In conclusion, the evaluation of pain in cats and dogs seemed to be affected by gender, previous work experience, and degree of training in this preliminary study. Further investigation into the impact of teaching methods and demographics is required to confirm and better understand these results.

References
Comparative efficacy of intranasal and injectable vaccines in stimulating Bordetella bronchiseptica-reactive anamnestic antibody responses in household dogs

John A. Ellis, Sheryl P. Gow, Lindsey B. Lee, Stacey Lacoste, Eileen C. Ball

Abstract — In order to determine the comparative efficacy of injectable and intranasal vaccines to stimulate Bordetella bronchiseptica (Bb)-reactive anamnestic antibodies, a trial was conducted using 144 adult household dogs of various breeds and ages, which had been previously administered intranasal Bb vaccine approximately 12 months before enrollment. Dogs were randomized into 2 groups and blood, nasal swabs, and pharyngeal swabs were collected prior to the administration of single component Bb vaccines intranasally or parenterally. Ten to 14 days later all dogs were resampled to measure changes in systemic and local antibody to Bb. There were no differences in the changes in Bb-reactive serum IgG and nasal IgA between the groups, whereas intranasally vaccinated dogs had significantly higher Bb-reactive serum IgA. These data indicate that both of the current generation of intranasal (modified-live) and injectable (acellular) Bb vaccines can stimulate anamnestic local and systemic antibody responses in previously vaccinated, Bb-seropositive adult household dogs.

Résumé — Efficacité comparative des vaccins intranasaux et injectables pour stimuler les réponses des anticorps anamnestiques réagissant à Bordetella bronchiseptica chez les chiens domestiques. Afin de déterminer l’efficacité comparative des vaccins injectables et intranasaux pour stimuler les anticorps anamnestiques réagissant à Bordetella bronchiseptica (Bb), un essai a été réalisé à l’aide de 144 chiens domestiques adultes de diverses races et d’âges différents, auxquels l’on avait déjà administré le vaccin Bb intranasal environ 12 mois avant le recrutement. Les chiens ont été assignés au hasard à deux groupes et des échantillons sanguins, nasaux et pharyngés ont été prélevés avant l’administration de vaccins Bb à composant unique soit par voie intranasale ou parentérale. Dix à 14 jours plus tard, on a prélevé de nouveaux échantillons pour tous les chiens afin de mesurer les changements dans les anticorps systémiques et locaux pour Bb. Il n’y avait aucune différence au niveau des changements pour l’IgG sérique et l’IgA nasal réactif à Bb entre les groupes, tandis que les chiens vaccinés par voie intranasale présentaient un niveau significativement supérieur d’IgA sériques réactives à Bb. Ces données indiquent que les deux générations actuelles de vaccins Bb intranasal (vivant modifié) et injectable (acellular) peuvent stimuler les réponses locale et systémique des anticorps Bb chez les chiens adultes domestiques antérieurement vaccinés.

(Traduit par Isabelle Vallières)
Introduction

* Bordetella bronchiseptica* (*Bb*) is a Gram-negative bacterium that is one of about 12 pathogens that have been causally associated with the canine infectious respiratory disease complex (CIRDC) (1). Various parenteral and mucosal vaccines against *Bb* are available and have frequently been used in veterinary practices for more than 30 y (2). Throughout this period there has been controversy about the relative efficacy of these vaccines in stimulating primary protective immune responses and in their comparative utility as “booster shots” (2).

Environmental co-factors, such as natural exposure to *Bb*, that could provide a “boosting” effect for iatrogenically primed immune responses likely significantly contribute to vaccine efficacy and duration of immunity (DOI) in client-owned dogs (3,4). The involvement of these cofactors, including dose and frequency of *Bb* exposure in settings such as boarding kennels and grooming operations, is virtually impossible to model in a laboratory setting, requiring the use of household dogs to best gauge the Gestalt of immunity to *Bb* and other pathogens. For various reasons, perhaps most notably logistical difficulties related to owner participation and compliance, there are few studies that have sequentially examined immune responses to *Bb* vaccines in real-world dogs (5). Neither are there many recent data concerning the carriage of *Bb* in clinically normal household dogs, that could affect responses to vaccination and DOI (6,7). The purpose of this study was to extend extant laboratory findings related to the immunogenicity of *Bb* vaccines by comparing the anamnestic systemic and mucosal antibody responses induced by the current generation of injectable or intranasal single component *Bb* vaccines in adult household dogs presenting for their annual “booster shots.”

Materials and methods

Study population and experimental design

Clinically normal client-owned household dogs of various ages and breeds (Table 1) with a documented history of intranasal vaccination for *Bb* approximately 1 y before enrollment (a common and often recommended interval between vaccinations for *Bb*) (2) were subjects, and had written owner consent. Owners were questioned regarding their dogs’ lifestyle as related to potential exposures to other dogs. Patients were randomized to 2 groups using a computerized random number generator. Dogs in 1 group received a single injectable *Bb* vaccine; those in the other received a single intranasal vaccine. When there were 2 or more dogs in a household, all dogs received the same treatment. Venous blood (for serum), nasal swabs (sterile polyester tipped), and pharyngeal swabs were collected on day 0 prior to vaccination and again 10 to 14 d later. Individual swabbing was performed in both nares, left first, and then in the deep pharynx (including tonsil whenever possible). All sampling was done away from owners, and fractious dogs were mildly sedated, if necessary. Only pharyngeal swabbing was done in dogs with stenotic nares (i.e., too small to insert swab). Nasal swabs were placed in 1 mL, and pharyngeal swabs in 2 mL, of transport medium and frozen at −20°C, then −80°C prior to analysis.

Vaccines

Single component injectable (Bronchicine; Zoetis, Parsippany, New Jersey, USA) and intranasal (Vanguard B; Zoetis) *Bb* vaccines were obtained from a distributor.

Quantitation of *Bb*-reactive antibodies

Enzyme-linked immunosorbent assays (ELISAs) to measure IgG and IgA reactive with *Bb* were performed as previously described (8) using *Bb*-antibody positive and negative sera and saliva as controls.

Polymerase chain reaction (PCR)

A real time PCR for *Bb* (and other respiratory pathogens; RealPCR test code 2524; Idexx Reference Laboratories, Calgary, Alberta) was performed on deep pharyngeal swabs.

Statistical analysis

Statistical analyses were performed using a commercial software package (SPSS Statistics 23.0; IBM, Markham, Ontario). Changes in *Bb*-reactive serum IgG, serum IgA, and nasal IgA between the enrollment/vaccination visit and the follow-up visit were the 3 outcome variables examined. Non-parametric Mann-Whitney U-tests were used to determine the differences between treatment groups (9). Baseline data collected from the primary visit were also used to examine the secondary hypothesis that activities which increase the likelihood of interaction with other dogs increase the chance of natural exposure to *Bb*, and subsequently provide a “boosting” effect for iatrogenically primed immune responses. A score was created for each dog by categorizing the potential risk of natural *Bb* exposure based on activities (boarding, grooming, etc.) which could increase interaction with other dogs in the 12 mo prior to the onset of the study (Table 2). These categories were then summed for each dog in order to create a total risk score. The risk for natural *Bb* exposure was considered greater for dogs with a higher total score for these parameters. The relationships between baseline IgG or IgA and the total risk score for potential natural *Bb* exposure were examined using a Spearman’s correlation (10).

Results

A total of 144 dogs were enrolled between September 4, 2014 and October 28, 2015. Seventy-seven dogs were randomly assigned to the injectable *Bb* vaccine group and 67 to the intranasal *Bb* vaccine group. Before initiation of the study, historical data revealed that there were 22 dogs in the injectable *Bb* vaccine group which were vaccinated for *Bb* between January and November of 2013, and 55 dogs vaccinated between January and October of 2014. In the intranasal *Bb* vaccine group, there were 16 dogs vaccinated between July and December of 2013, 50 dogs vaccinated between January and October of 2014, and 1 dog in May of 2012. There was no statistical difference in the previous vaccination dates between the 2 treatment groups (P = 0.87).

There were also no statistical differences between breed classification (large, medium, small) between the 2 treatment groups (Table 1, P = 0.24). The dogs in the injectable *Bb* vaccine group and the intranasal *Bb* vaccine group were also not different from
each other for any of the other potential confounding variables explored (Bb exposure variables, Tables 2, 3 and baseline Bb-reactive antibodies, Table 4).

In a subset of dogs the Bb-reactive serum IgG (n = 9 dogs), serum IgA (n = 12 dogs) and nasal IgA (n = 30 dogs) decreased between the enrollment/vaccination visit and follow-up visits. Therefore, when calculating the change in these parameters from baseline a negative value was obtained. Since, it is biologically less probable to have these parameters decrease in the 10- to 14-day period between the initial vaccination and follow-up visit there was uncertainty as to the best way to manage these data. To ensure that either including or excluding dogs that had lower serum IgG, IgA, and/or nasal IgA after vaccination did not bias the outcomes, the data were analyzed using 5 approaches; dogs that had a lower serum IgG on the post-vaccination visit excluded, dogs that had a lower serum IgA on the post-vaccination visit excluded, dogs with a lower serum IgG, IgA, or nasal IgA on the post-vaccination visit excluded and no dogs excluded. Interpretation of the analyses for both the explanatory variables or primary outcomes of interest did not change regardless of the dataset used; therefore, for brevity only the analysis for all of the enrolled dogs is presented.

The changes in Bb-reactive serum IgG and nasal IgA were not significantly different between the 2 vaccination types (Table 5: Figures 1, 2); whereas the change in Bb-reactive serum IgA was significantly higher in the intranasally vaccinated (median = 32, range –42 to 154) versus the injected dogs (median 16, range –32 to 103) (Table 5; Figure 3) (P = 0.007).

There was no statistical association between the calculated total lifestyle risk score for potential natural Bb exposure and baseline IgG (P = 0.12) or IgA (P = 0.93).

Pharyngeal swabs from 4/101 dogs from 2014 (3 injectable-vaccinated/1 intranasally vaccinated) were positive for Bb DNA. Because of the low prevalence and variable baseline and post-vaccination responses, the pharyngeal swab data were not further analyzed.

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<th>Intranasal</th>
<th>Total</th>
</tr>
</thead>
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<td>1</td>
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</tr>
<tr>
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</tr>
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<td><strong>12</strong></td>
<td><strong>23</strong></td>
</tr>
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</table>

**Table 1.** Dog breeds categorized by treatment group and breed size
 Discussion

The results of this study extend our previous investigations related to the immunogenicity of the current generation of parenteral vaccines for Bb in dogs, an acellular nonadjuvanted filtrate preparation similar to the vaccines used against Bordetella pertussis (Bp) in humans (5,10). To our knowledge, this is the first study to compare the ability of injectable and intranasal vaccines to stimulate anamnestic mucosal and systemic antibody responses in a large cohort of previously intranasally vaccinated, variably Bb seropositive adult household dogs.

To the extent that there were no significant differences in the change in Bb-reactive IgG responses in serum between groups that received the injectable versus intranasal vaccines, these results are in contrast to a previous study that documented significantly higher systemic antibody responses, that developed more rapidly in parenterally vaccinated Bb-seropositive adult laboratory beagles compared to a similar group of intranasally vaccinated dogs (8). That study examined a whole cell alum-adjuvanted bacterin; therefore, it is perhaps not surprising that the latter vaccine was apparently more immunogenic since it contained orders of magnitude more of the protein antigen (5,8,10). As well, the whole cell bacterin contained more and different pathogens associated molecular patterns (PAMPs) or “danger signals” that likely had adjuvant activity (5,10,11,12) in addition to the inclusion of aluminum hydroxide.

In human medicine, until about the early 1990’s, various whole cell Bp vaccines were used to successfully control whooping cough in vaccinated populations (10). However, these vaccines were associated with an approximately 50% incidence of adverse reactions, most often local inflammatory reactions and/or transient malaise and pyrexia (10). It is most likely that the PAMPs in the whole cell vaccines were responsible for not only adjuvant effects but also for inducing the inflammatory responses that constituted the majority of the adverse reactions (10,12). These adverse reactions were a main instigator in the development of less reactive acellular vaccines containing both less PAMPs and less potential antigens (10). The adverse reaction rate to the previously widely used whole cell Bb vaccines in dogs was apparently considerably less than with the Bp vaccines according to available, primarily anecdotal data; however, there is a dearth of reliable prevalence data on adverse reactions.
to *Bb* vaccines in dogs. Nevertheless, a similar desire to reduce perceived reaction rates was a major reason for the development of the current acellular *Bb* vaccine. Therefore, a safety-driven “parallel-evolution” has occurred in human and veterinary medicine related to vaccines for relevant *Bordetella* spp., resulting in less reactive acellular vaccines. However, as part of that process it is important to acknowledge the expected “trade-off” between overall immunogenicity and less reactogenicity; it is generally not biologically possible to have both (10,12,13).

It was of interest that in some dogs, *Bb*-reactive antibodies in the serum and nasal secretions apparently decreased 10 to 14 d after vaccination. In the case of the nasal secretions, this could simply be a sampling “artifact” related to the volume of nasal secretion collected on the swabs prior to placement into a standard amount of transport medium; there is a high degree of variation in collection of these samples. This factor is difficult to control, especially when collecting from client-owned dogs, with variably sized, often small, nares. This constraint alludes to the logistical difficulty of conducting minimally invasive studies in household dogs, and warrants the use of the immunological surrogate, serum IgA, as an indicator of a relevant mucosal response (14). In the case of serum antibodies this possible dilution effect is not relevant, as a standard dilution of serum is tested in the ELISAs. A decrease in antibody 10 to 14 d after antigen exposure in serum or nasal secretions could be an indicator of a variable lack of response to the vaccine in an already antibody positive animal, in combination with a decay in antibody related to the expected half-life of those proteins in plasma and on mucosal surfaces, and/or immune complexing of antibody with vaccinal antigens (15). Alternatively, an apparent decrease in antibody measured in the ELISAs which used a whole cell preparation of *Bb* as antigen, could be due to the failure to accurately measure responses to immunodominant *Bb* antigens or different IgG subtype antibody responses in different dogs (13,16,17). In other words, after boosting with vaccine some dogs may respond preferentially to particular antigens versus others, which could then be detected in an apparent overall decrease in reaction with the standardized constellation of antigens in the whole cell preparation used as the ELISA antigen.

The site of production and immunological relevance of canine serum IgA has been controversial (18,19). The finding that most adult dogs in this study that received intranasal vaccine had increases in *Bb*-reactive IgA in the serum post-vaccination is consistent with the concept, based primarily on studies in the gut, that mucosal production following antigen exposure is consistent with the concept that parenteral immunization to boost measurable IgA on non-diseased mucosal surfaces, and there are few comparative data that address this issue. Although the numbers of nasal swab samples were decreased compared to serum, the finding that there were no significant differences in mucosal *Bb*-reactive IgA in the groups of dogs that received injectable or intranasal vaccines is consistent with the concept that parenteral administration of vaccine can result in increases in antigen-specific IgA in nasal secretions in mucosally-primed individuals (23). More relevant to *Bb*, it has been demonstrated that parenteral vaccination of previously naturally exposed human adolescents with acellular *Bp* (DTaP) stimulated not only anamnestic *Bp*-specific IgG responses, but IgA as well (24). This was not the case following primary parenteral immunization with the DTaP vaccine indicating

<table>
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<td>Number of dogs</td>
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<td>Male</td>
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**Table 4.** Descriptive statistics and associated *P*-values for dog gender, age, baseline *Bordetella bronchiseptica* (*Bb*)-specific serum IgG, baseline *Bb*-specific serum IgA and baseline *Bb*-specific nasal IgA

**Table 5.** Descriptive statistics and associated *P*-values for the 3 outcomes of interest; change in *Bordetella bronchiseptica* (*Bb*)-specific serum IgG, change in *Bb*-specific serum IgA, and change in *Bb*-specific nasal IgA between initial and final sampling

<table>
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<tr>
<th>Variable</th>
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<tr>
<td></td>
<td>−39 to 69</td>
<td></td>
</tr>
<tr>
<td>Change in <em>Bb</em>-specific serum IgA</td>
<td>77</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>−32 to 103</td>
<td></td>
</tr>
<tr>
<td>Change in <em>Bb</em>-specific nasal IgA</td>
<td>60</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td>−83 to 76</td>
<td></td>
</tr>
</tbody>
</table>

**Table 4.** Descriptive statistics and associated *P*-values for dog gender, age, baseline *Bordetella bronchiseptica* (*Bb*)-specific serum IgG, baseline *Bb*-specific serum IgA and baseline *Bb*-specific nasal IgA
that mucosal priming was required to affect the latter response (24). The practical implication from these observations is that priming puppies with intranasal vaccine followed by parenteral delivery in an initial series achieves boosting of both systemic and mucosal antibody responses (25,26).

It was suggested 40 y ago that natural transmission of Bb from clinically affected, convalescent, or asymptomatic carrier dogs could contribute to the duration of immunity to Bb, and that this effect could vary with a dog’s “lifestyle” (3). We were unable to associate the lifestyle co-factor of potential exposure to other dogs with baseline antibody responses to Bb in this cohort of dogs. This may be due to limitations of the data such as recall bias of owners, inadvertently missing or misclassifying key exposure risk(s), or an inability to quantify the exposure risk appropriately; for example, a lack of knowledge related to the “circulation” of Bb in subsets of the canine population. Data concerning the carriage of Bb by asymptomatic dogs are somewhat conflicting. Early studies based on culture reported no isolation of Bb in 2 populations of laboratory beagles [n = 467 (27); n = 25 (28)], and 3/50 (6.0%) asymptomatic dogs entering, or housed in a university veterinary clinic (29) were Bb culture positive. In recent studies using potentially more sensitive PCR, 2/22 (9.1%) normal dogs presenting at veterinary clinics (7) and 98/503 (19.5%) asymptomatic dogs presenting at shelters were positive for Bb DNA (30). Unfortunately, the immune status to Bb was not known/reported in any of those studies. Based on the low prevalence of Bb positive dogs (4%) in this population of routinely vaccinated dogs, carriage of Bb could not be implicated as an important co-factor in the response to Bb vaccines in this study. Nevertheless, exposure to Bb from acutely infected individuals, carrier animals, or fomites is undoubtedly an important, if difficult to measure co-factor in the response to Bb vaccines (4), which begs further investigation.

In conclusion, these data demonstrate that both intranasal and parenteral administration of current vaccines for Bb to previously intranasally vaccinated variably Bb seropositive adult household dogs can stimulate anamnestic systemic and mucosal antibody responses that have been associated with disease sparing in Bordetella infections (10,25). Therefore, these data suggest that either vaccine could be considered for use as a booster in animals with immunological memory established by previous immunization (25) and/or natural exposure.
Acknowledgments
This work was supported in part by an unrestricted grant from Zoetis to study the clinical immunity to *Bt* vaccines, and by the principal author’s discretionary funds to study clinical immunology.

References
Elanco launches Component® TE-G with Tylan® In Canada!

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Producers can trust the only implant that offers the added value of Tylan’s abscess defense to help protect and maximize their implant ROI. Elanco offers Zero-Defect Implanting (ZDI) which includes training on sanitation protocols, guidance on critical control points and ear check services for quality control; all great resources to bring you, our valued customers, increased value. Maximize implant ROI by minimizing defects today by contacting your Elanco Sales Representative for more information on TE-G with Tylan and all other Elanco implants.

Please refer to the product label which contains complete use information, including cautions and warnings. Always read, understand and follow the label and use directions.

References

Based on grazing implant data presented by Kuhl and the calculated value of gain described by Peel using current economic data means.

Contact: Elanco Canada Ltd., 150 Research Lane, Suite 120, Guelph, ON N1G 4T2; website: www.elanco.ca
Blood lactate concentration in diabetic dogs

Poliana Claus, André M. Gimenes, Jacqueline R. Castro, Matheus M. Mantovani, Khadine K. Kanayama, Denise M.N. Simões, Denise S. Schwartz

Abstract — Human diabetic patients may have increased lactate levels compared to non-diabetics. Despite the use of lactate levels in critical care assessment, information is lacking for diabetic dogs. Therefore, this prospective cross-sectional clinical study aimed to determine lactate concentrations in 75 diabetic dogs (25 newly diagnosed non-ketotic diabetics, 25 under insulin treatment, and 25 in diabetic ketoacidosis (DKA)), compared to 25 non-diabetic dogs. Lactate levels (mmol/L) were not different among groups \((P = 0.20)\); median and 25th to 75th percentile were 2.23 and \(P_{25-75} = 1.46\) to 2.83 for controls, 1.69 and \(P_{25-75} = 1.09\) to 2.40 for newly diagnosed non-ketotic diabetics, 2.27 and \(P_{25-75} = 1.44\) to 2.90 for dogs under insulin treatment for at least 30 days, and 2.40 and \(P_{25-75} = 1.58\) to 3.01 for dogs in DKA. Longitudinal studies assessing both isomers (L- and D-lactate) are needed to better elucidate the role of lactate in the pathophysiology of diabetes acid-base status in dogs.

Résumé — La concentration de lactate de sang chez les chiens diabétiques. Des patients humains avec diabète peuvent présenter augmentation des niveaux de lactate, quand comparés aux non diabétiques. Bien que est utilisé d’évaluer les patients dans un état critique, cette information manque pour les chiens diabétiques. Par conséquent, cette étude clinique s’agit d’une prospective transversale en vue de déterminer les concentrations du lactate en 75 chiens diabétiques (25 au moment du diagnostic, 25 sous traitement à l’insuline et 25 dans l’acido-cétose diabétique (ACD)), par rapport aux 25 chiens non diabétiques. Les niveaux de L-lactate ne différaient pas entre les groupes \((P = 0.20)\). Les valeurs médianes et les centiles 25 % et 75 % étaient de 2.23 mmol/L \(P_{25-75} = 1.46\) à 2.83 pour les contrôles, 1.69 mmol/L \(P_{25-75} = 1.09\) à 2.40 au diagnostic, 2.27 mmol/L \(P_{25-75} = 1.44\) à 2.90 sous traitement à l’insuline pendant au moins 30 jours, et 2.40 mmol/L \(P_{25-75} = 1.58\) à 3.01 dans ACD. Des études longitudinales évaluant les deux isomères (L et D-lactate) sont nécessaires pour élucider son rôle dans la physiopathologie et le déséquilibre acide-base chez les chiens diabétiques.

(Traduit par Ana Carolina Possas Viana)

Can Vet J 2017;58:817–822

Introduction

Lactate, a product of glucose anaerobic metabolism, is considered a diagnostic and prognostic biomarker for shock in human and veterinary medicine, and can be considered as a marker for detecting hypoperfusion, although with some limitations (1). Poor tissue perfusion/oxygenation is strongly correlated with morbidity and mortality (2–6).

The imbalance between lactate production, breakdown, and clearance, will be reflected in circulating lactate concentration (7). Hyperlactatemia, a persistent increase in blood lactate concentration, can arise from impaired tissue oxygenation (hypoxic) and also from non-hypoxic processes, and may result in lactic acidosis (7–9). The most common identified form is Type A lactic acidosis, caused by hypoxic conditions, whereas Type B is secondary to non-hypoxic causes. Type B lactic acidosis is further divided into B1, B2, and B3 types. Type B1 is related to systemic diseases, and has been identified in human patients with diabetes mellitus (DM), malignancy, bowel disease, pancreatitis, infection, renal failure, hepatic failure, and other conditions. Type B2 includes causes related to some drugs (as metformin, beta-adrenergic agents, salicylates, sulfasalazine, and toxins) and Type B3 is related to inborn defects of metabolism such as some enzymes deficiencies (7–9). This classification is considered over-simplified by some authors, as in critical illness there is overlap of factors that influence lactate dynamics (9).

Lactate concentration is significantly higher in type II diabetic human patients than in controls, and it is higher in patients with severe glucose intolerance than in patients with mild glucose intolerance (10). It has also been reported that lactate concentration is consistently higher in human patients...
Diabetic ketoacidosis (DKA) is considered the main endocrine emergency in small animals (12), characterized by fluid, electrolyte, and acid-base imbalance, and is frequently associated with comorbidities and high mortality rates (13,14). Lactic acidosis has been reported in human diabetic patients (11) and may occur in dogs with DKA, contributing to metabolic acidosis (1). It is important to differentiate between lactic acidosis and ketoacidosis in acdemic diabetic patients, as a different treatment is required for each condition (7,15). The motivation for this study was the lack of information in the veterinary literature regarding lactate levels in diabetic dogs, as in humans it has been determined that non-ketotic diabetic patients have higher lactate levels compared with normal diabetics. Therefore, the aim of this study was to determine if newly diagnosed diabetics and known diabetics undergoing treatment for a minimum of 30 d have higher blood lactate concentrations than normal individuals. An additional goal was to determine if lactate concentrations differ among non-ketotic diabetics compared with patients with DKA. As a secondary objective, we aimed to determine whether lactate levels were associated with an increased likelihood of negative outcomes for DKA dogs (death or euthanasia due to non-improvement of DKA symptoms).

Materials and methods

A prospective cross-sectional clinical study was conducted following ethical principles of animal research, approved by the Institution Animal Use & Ethics Committee (Protocol: 2542/2012). Client-owned dogs presented to the Veterinary Teaching Hospital of the School of Veterinary Medicine and Animal Science, University of São Paulo, Brazil (94 dogs) or to a private Veterinary Hospital (6 dogs) between January 2011 and August 2013, were recruited consecutively.

Dogs were included if they had a diagnosis of diabetes mellitus and had been under treatment with insulin for more than 30 d, if they were newly diagnosed non-ketotic diabetics and if they were diagnosed with DKA and were under treatment or newly diagnosed. The exclusion criterion for all the groups was the presence of any of the following comorbidities: acute hepatic failure, renal failure, heart failure, advanced respiratory disease, anticonvulsive therapy, sepsis, septic and cardiogenic shock, as these conditions may alter lactate levels. Dogs with DKA had similar exclusion criteria, with the exception of comorbidities and high mortality rates (13,14). Lactic acidosis has been reported in human diabetic patients (11) and may alter lactate levels. Dogs with DKA had similar exclusion criteria to compare all groups for gender distribution. Fisher’s exact test was used for comparison of groups for non-parametric variables, followed by Dunn’s test. Spearman correlation was used to assess relations between lactate levels and glycermia, blood urea nitrogen (BUN), creatinine, anion gap, and β-hydroxybutyrate, as well as correlation between pH and lactate, BUN and creatinine. A Chi-squared test was used to compare all groups for gender distribution. Fisher’s exact test was applied to evaluate association between increased lactate levels and mortality risk. A Mann-Whitney test was used as a post-hoc subgroup analysis to compare DKA dogs that were already under treatment with DKA dogs that were newly diagnosed for analyzed variables (blood glucose, lactate, pH, anion gap, creatinine, BUN).

Spearman correlation was used to assess the relation between the measured variables of interest, including the whole study
population. Fisher’s exact test was used to assess, as a secondary aim, whether lactate was associated with a negative outcome in DKA patients (death or euthanasia due to non-improvement of DKA symptoms).

Statistical analysis was performed using GraphPad Prism version 5.0 (San Diego, California, USA). Values of $P < 0.05$ were considered significant.

### Results

Groups were equivalent with respect to gender and weight distribution. Diabetic groups were older than the control group ($P < 0.0001$) (Table 1).

Mixed breed dogs were predominant (27%), followed by miniature poodle (13%), Labrador (8%), and dachshund (5%). Other breeds (bichon frise, bull terrier, bulldog, cocker spaniel, Dalmatian, Brazilian terrier, golden retriever, Siberian husky, lhasa apso, Maltese, German shepherd, miniature pinscher, pit bull, pug, Rottweiler, miniature schnauzer, shar-pei, and shih tzu) were less than 5% each.

Factors that may have contributed to DKA were urinary tract infection ($n = 13$), hyperadrenocorticism ($n = 8$), corticosteroid use ($n = 7$), mammary tumor, diestrus, obesity ($n = 2$ each), pancreatitis, abscess, and estrus ($n = 1$ each). Among the dogs with DKA, 15 were newly diagnosed cases of DM.

By definition, dogs in diabetic groups had higher glycemic values than controls. Blood glucose levels were significantly higher in dogs with newly diagnosed DM and those with DKA compared with those under treatment ($P < 0.0001$) (Figure 1A).

![Figure 1A](image1)

**Figure 1A.** Box-and-whisker plots representing (A) glucose (mmol/L) and (B) lactate (mmol/L) concentration. Median and interquartile range (box), and minimum and maximum values (whiskers) in study groups (control, at diagnosis, under insulin treatment, DKA). Note that diabetic dogs under treatment show lower blood glucose values than those at diagnosis and DKA, but higher than controls ($P < 0.05$; Kruskal-Wallis/Dunn). Lactate concentrations were similar among groups.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Control $n = 25$</th>
<th>At diagnosis $n = 25$</th>
<th>Under treatment $n = 25$</th>
<th>DKA $n = 25$</th>
<th>Statistic $P$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender/Condition, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$\chi^2$</td>
</tr>
<tr>
<td>M 20 (55.9)</td>
<td>8 (66.7)</td>
<td>5 (83.3)</td>
<td>4 (50)</td>
<td>3 (37.5)</td>
<td>0.2372</td>
</tr>
<tr>
<td>CM 14 (41.2)</td>
<td>4 (33.3)</td>
<td>1 (16.7)</td>
<td>4 (50)</td>
<td>5 (62.5)</td>
<td></td>
</tr>
<tr>
<td>F 30 (45.5)</td>
<td>7 (53.8)</td>
<td>11 (57.9)</td>
<td>4 (23.5)</td>
<td>8 (47.1)</td>
<td></td>
</tr>
<tr>
<td>SF 36 (54.5)</td>
<td>6 (46.2)</td>
<td>8 (42.1)</td>
<td>13 (76.5)</td>
<td>9 (52.9)</td>
<td></td>
</tr>
<tr>
<td>Age (months)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Med (P25-P75)</td>
<td>53$^a$ (24–75.5)</td>
<td>118$^b$ (101.5–132)</td>
<td>120$^b$ (90–144)</td>
<td>120$^b$ (96–143)</td>
<td>KW</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$&lt; 0.0001$</td>
</tr>
<tr>
<td>Med (P25-P75)</td>
<td>18 (12.45–32.7)</td>
<td>9.8 (6.2–20.5)</td>
<td>8.9 (5.3–20.8)</td>
<td>14 (7.9–27.25)</td>
<td>$0.071$</td>
</tr>
</tbody>
</table>

DKA — diabetic ketoacidosis; M — male; CM — castrated male; F — female; SF — spayed female; $\chi^2$ — Chi-squared; KW — Kruskal-Wallis; Med — median; P$_{25}$ — 25th percentile; P$_{75}$ — 75th percentile.

$^a,b$ Different letters between groups show differences by Dunn’s test ($P < 0.05$).

![Figure 1B](image2)

**Figure 1B.** Box-and-whisker plots representing (A) glucose (mmol/L) and (B) lactate (mmol/L) concentration. Median and interquartile range (box), and minimum and maximum values (whiskers) in study groups (control, at diagnosis, under insulin treatment, DKA). Note that diabetic dogs under treatment show lower blood glucose values than those at diagnosis and DKA, but higher than controls ($P < 0.05$; Kruskal-Wallis/Dunn). Lactate concentrations were similar among groups.
anion gap ($r = 0.149$; $P = 0.17$). Correlations between variables are shown in Table 3. There was no association between lactate levels and outcome.

**Discussion**

Lactate concentration in diabetic dogs, newly diagnosed and under treatment, as well as in dogs with DKA was not significantly different from controls (Figure 1B), in this population. The lack of significant difference on lactate concentration among the groups may have been due to the study design, i.e., cross-sectional; in the study on non-insulin-dependent diabetic humans, the patients were followed for 24 h with sequential lactate measurements. In that study, non-obese patients with moderate-to-severe glucose intolerance had higher lactate levels compared to patients with normal glucose tolerance (10).

Our results also differed from a study that evaluated acid-base abnormalities and found higher lactate concentration in diabetic dogs compared to controls, with median values of 2.0 and 1.0 mmol/L, respectively; although all results were within normal ranges for dogs (20).

One possibility for not finding increased lactate levels in dogs with DKA, other than study design, may be that none of the dogs were in hypovolemic shock and, therefore, did not have the most common cause of hyperlactatemia (type A lactic acidosis). In DM, inadequate oxygen utilization by the tissues may also play a role in lactate increase rather than deficient oxygen supply (21). Considering the exclusion criteria, none of the dogs had systemic diseases, other than DM, that could account for type B1 lactic acidosis (7–9), except in a few of the DKA cases, which may not constitute enough power to detect a difference.

The positive correlation between lactate and glucose concentration noted by other authors (10,22) was not observed in this study. This finding may also be related to the fact that we had no dogs in critical condition, due to the adopted exclusion criteria. Lactate blood concentration was not correlated with any of the measured variables for this study population. In human diabetics under insulin treatment that were clinically stable, the correlation between lactate and glucose levels was observed on admission (23). In the present study (the study population included not only DKA, but non-ketotic diabetics that were newly diagnosed, non-ketotic diabetics under insulin treatment that were clinically stable, and healthy dogs), this association is understandable based on

<table>
<thead>
<tr>
<th>Table 2. Comparison of measured variables among groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
</tr>
<tr>
<td>Lactate (mmol/L)</td>
</tr>
<tr>
<td>Med</td>
</tr>
<tr>
<td>(P$<em>{25}$–P$</em>{75}$)</td>
</tr>
<tr>
<td>Glucose (mmol/L)</td>
</tr>
<tr>
<td>Med</td>
</tr>
<tr>
<td>(P$<em>{25}$–P$</em>{75}$)</td>
</tr>
<tr>
<td>Anion gap (mmol/L)</td>
</tr>
<tr>
<td>Med</td>
</tr>
<tr>
<td>(P$<em>{25}$–P$</em>{75}$)</td>
</tr>
<tr>
<td>Sodium (Na) (mmol/L)</td>
</tr>
<tr>
<td>Med</td>
</tr>
<tr>
<td>(P$<em>{25}$–P$</em>{75}$)</td>
</tr>
<tr>
<td>Potassium (K) (mmol/L)</td>
</tr>
<tr>
<td>Med</td>
</tr>
<tr>
<td>(P$<em>{25}$–P$</em>{75}$)</td>
</tr>
<tr>
<td>Chloride (Cl) (mmol/L)</td>
</tr>
<tr>
<td>Med</td>
</tr>
<tr>
<td>(P$<em>{25}$–P$</em>{75}$)</td>
</tr>
<tr>
<td>Ionized calcium (iCa) (mmol/L)</td>
</tr>
<tr>
<td>Med</td>
</tr>
<tr>
<td>(P$<em>{25}$–P$</em>{75}$)</td>
</tr>
<tr>
<td>Beta-OHB (mmol/L)</td>
</tr>
<tr>
<td>Med</td>
</tr>
<tr>
<td>(P$<em>{25}$–P$</em>{75}$)</td>
</tr>
<tr>
<td>Urea nitrogen (BUN) (mmol/L)</td>
</tr>
<tr>
<td>Med</td>
</tr>
<tr>
<td>Creatinine (mmol/L)</td>
</tr>
<tr>
<td>Med</td>
</tr>
<tr>
<td>(P$<em>{25}$–P$</em>{75}$)</td>
</tr>
</tbody>
</table>

DKA — diabetic ketoacidosis; Beta-OHB — beta-hydroxybutyrate; Med — median; P$_{25}$ — 25th percentile; P$_{75}$ — 75th percentile.

$^{a,b,c}$ Different letters between groups show differences by Dunn’s test ($P < 0.05$).
the pathophysiology of DKA. An absolute or relative insulin deficiency or insulin resistance facilitated by a comorbidity and secondary increase in cortisol, epinephrine, and glucagon leads to increased breakdown of triglycerides due to cellular starvation, with consequent production of β-OHB, derived from Acetyl-Coenzyme A (24,25).

Glycemia levels were positively correlated with BUN, but not with creatinine in this cohort. This is probably related to pre-renal azotemia secondary to increased diuresis related to glucosuria (osmotic diuresis), but there are other possibilities.

Blood urea nitrogen levels can rise in situations of increased production of urea, by excessive protein catabolic rate, decrease in glomerular filtration rate, and increase in tubular urea absorption, influenced by antidiuretic hormone (ADH) (26–28). The clinical syndrome of pre-renal or functional renal failure, also referred to as pre-renal azotemia, is characterized by a disproportionate increase in BUN in relation to creatinine (high BUN to creatinine ratio) and a low urine volume, in the presence of an intact renal parenchyma, and related to renal hypoperfusion (27,28). There are, however, situations in which urine flow may be high (28), as with corticosteroid use and osmotic diuresis (as happens in DM).

However, the antidiuretic hormone released in response to hypovolemia and/or hypotension, also plays a role as it increases reabsorption of both water and urea in the distal renal tubules (30), based on that fact that urea can “back-diffuse” into papillary interstitium under the influence of ADH (28). Both hypovolemia and increased plasma osmolarity contribute to ADH secretion; therefore, hypovolemia was probably not the only factor involved, since DKA patients may have increased plasma osmolarity because of hyperglycemia. Other causes for volume depletion are extra-renal fluid loss (vomiting, diarrhea).

Diabetic ketoacidosis patients may have all these contributions to the enhanced blood urea concentration, as pre-renal factors. Besides those, gastrointestinal (GI) bleeding cannot be ruled out, although none of our patients had overt GI blood loss. We did not assess the amount of protein intake in these dogs, and the DKA dogs were anorexic. In dogs with DKA, there is an increased protein catabolic state (26), which may also contribute to increased plasma BUN.

The negative weak correlation between BUN and pH may be explained by a metabolic acidemia related to azotemia. The moderate negative correlation between β-OHB and blood pH is in agreement with the ketoacidosis state.

Hyropertfusion and ketosis are not the exclusive reasons to explain the acidic state in DKA, as changes in glucose metabolism and reduction of lactate removal from circulation may play a role (1,6), which deserves more investigation regarding DM pathophysiology and its complications.

The equipment routinely used for lactate measurement assesses L-lactate isomer, the predominant portion derived from pyruvic acid breakdown in anaerobic conditions. D-lactate is produced from methylglyoxal (MG) and is increased in diabetic humans and animals, possibly caused by increased production of its precursor in these subjects (31,32). The handheld analyzer (i-STAT) used herein for measurement of lactate, measures only its precursor in these subjects (31,32). The handheld analyzer (i-STAT) used herein for measurement of lactate, measures only 2-bicarbonate. Significant correlations are indicated in bold font within the table.

## Table 3. Spearman’s Rank-Order Correlation between the measured variables of interest, including the whole study population (n = 100)

<table>
<thead>
<tr>
<th>Glycemia</th>
<th>BUN</th>
<th>Creatinine</th>
<th>pH</th>
<th>β-OHB</th>
<th>Anion gap</th>
<th>HCO₃⁻</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactate</td>
<td>r = 0.05 P = 0.62</td>
<td>r = 0.09</td>
<td>r = 0.02</td>
<td>r = -0.16 P = 0.11</td>
<td>r = 0.01 P = 0.07</td>
<td>r = 0.15 P = 0.17</td>
</tr>
<tr>
<td>Glucose</td>
<td>r = 0.25 P = 0.02</td>
<td>r = 0.005</td>
<td>r = -0.18 P = 0.07</td>
<td>r = 0.66 P &lt; 0.0001</td>
<td>r = 0.07 P = 0.53</td>
<td>r = -0.10 P = 0.32</td>
</tr>
<tr>
<td>BUN</td>
<td>r = 0.48 P &lt; 0.0001</td>
<td>r = -0.20</td>
<td>r = 0.23 P = 0.02</td>
<td>r = -0.36 P = 0.0007</td>
<td>r = -0.06 P = 0.54</td>
<td></td>
</tr>
<tr>
<td>Creatinine</td>
<td>r = -0.18 P = 0.08</td>
<td>r = 0.17 P = 0.09</td>
<td>r = -0.11 P = 0.30</td>
<td>r = -0.14 P = 0.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>r = -0.47 P &lt; 0.0001</td>
<td>r = -0.37</td>
<td>r = 0.68 P = 0.0005</td>
<td>r = 0.005 P &lt; 0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>β-OHB</td>
<td>r = 0.30 P = 0.005</td>
<td>r = -0.45 P &lt; 0.0001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anion gap</td>
<td>r = -0.61 P &lt; 0.0001</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BUN — blood urea nitrogen; β-OHB — beta-hydroxybutyrate; HCO₃⁻ — bicarbonate. Significant correlations are indicated in bold font within the table.
one study (20). In order to determine whether diabetic dogs and dogs with DKA also have increased D-lactate, specific methods must be used, as the ones routinely used measure only L-lactate. Consistently elevated lactate has been reported in stable human patients with Type 1 DM compared with non-diabetics, and 10% to 15% of DKA patients have elevated lactate concentrations ( > 5 mmol/L) (11). A similar percentage (~ 12%) was observed in another study in humans (23). In the present study, 16% of dogs in DKA had a lactate concentration > 5 mmol/L, even though the comparison of groups did not show a significant difference for lactate values. Lactate levels were not associated with outcome in the DKA group; however, this was a secondary analysis and may be underpowered to answer this question.

In conclusion, the most common clinically measured lactate isomer, L-lactate, plasma concentration was not different in diabetic dogs, compared with healthy dogs. Dogs with DKA may present with a higher lactate concentration depending on the status of patients, related to tissue perfusion; however, this observation was not observed herein, probably because the patients were not severely hypovolemic. Longitudinal studies that assess both isomers (L- and D-lactate) and include more severely ill diabetic dogs are needed to better elucidate the role of these isomers in the pathophysiology of diabetes acid-base status in dogs.

Acknowledgments

The authors thank the entire Veterinary Hospital of the School of Veterinary Medicine and Animal Science, University of São Paulo (USP). We also acknowledge the institutional support, the Department of Internal Medicine (VCM) FMVZ-USP, and a financial grant by FAPESP (Process n. 2011-21116-1) and CAPES. We also thank Ms. Maria Amelia Ahren Beraldo for reviewing the French translation of the abstract.

References

Response to acupuncture treatment in horses with chronic laminitis

Babak Faramarzi, Dongbin Lee, Kevin May, Fanglong Dong

Abstract — There is a need for evidence-based scientific research to address the question of the effectiveness of acupuncture in improving clinical signs of laminitis in horses. The objective of this study was to compare lameness levels before and after 2 acupuncture treatments in horses with chronic laminitis. Twelve adult horses with chronic laminitis received 2 acupuncture treatments 1 week apart. The points were treated using dry needling, hemoa-cupuncture, and aqua-acupuncture. Lameness level was objectively evaluated using an inertial sensor-based lameness evaluation system (Lameness Locator), as well as routine examinations following American Association of Equine Practitioners scoring before the first and 1 week after the second acupuncture treatment. Data were analyzed using Wilcoxon signed-rank test and \( P \)-values, \( 0.05 \) were considered statistically significant. Both the Lameness Locator \( (P = 0.0269) \) and routine lameness examination \( (P = 0.0039) \) showed a significant reduction in lameness severity. Our results support using acupuncture, along with other treatment options, in treating chronic equine laminitis.

Résumé — Réponse à un traitement à l’acupuncture chez des chevaux atteints de laminite chronique. Il existe un besoin de recherche scientifique factuelle afin d’aborder la question de l’efficacité de l’acupuncture pour améliorer les signes cliniques de la laminite chez les chevaux. L’objectif de cette étude consistait à comparer les niveaux de boiterie avant et après deux traitements d’acupuncture chez des chevaux atteints de laminite chronique. Douze chevaux adultes souffrant de laminite chronique ont reçu deux traitements d’acupuncture à 1 semaine d’intervalle. Les points ont été traités en utilisant des aiguilles, l’hémo-acupuncture et l’aqua-acupuncture. Le niveau de boiterie a été évalué objectivement en utilisant un système inertiel d’évaluation de la boiterie à base de sonde (repérage de la boiterie) ainsi qu’à l’aide d’examens de routine en se basant sur la notation de l’American Association of Equine Practitioners avant le premier traitement et 1 semaine après le deuxième traitement d’acupuncture. Les données ont été analysées en utilisant les tests de rang signés de Wilcoxon et des valeurs \( P < 0.05 \) étaient considérées comme étant significatives sur le plan statistique. Le repérage de la boiterie \( (P = 0.0269) \) et l’examen de routine de la boiterie \( (P = 0.0039) \) ont montré une réduction significative de la gravité de la boiterie. Nos résultats appuient l’utilisation de l’acupuncture, conjointement à d’autres options de traitement, pour traiter la laminite équine chronique.

Introduction

Laminitis is a complicated and interrelated sequence of inflammatory and vascular events which affect the lamellar tissues of the hoof. These events result in breakdown of interdigitation between the epidermal and dermal lamellae which consequently inflicts severe pain and disability in horses (1). Within the horse population, laminitis is a common and severe disease. A previous study reported that 13% of horse operations were affected by laminitis annually (2). Furthermore, 48% of horses with laminitis referred to veterinary teaching hospitals were eventually euthanized (3). Though several theories have been presented, including mechanical, metabolic, and nutritional disorders, the etiology and pathogenesis of laminitis remain inconclusive and largely unknown; the treatment options therefore have only a limited scientific basis (4,5). Generally, multi-modal and symptomatic therapy has been indicated including medication, mechanical support, and dietary restriction (1). However, efficacy is often limited and, at times, euthanasia is inevitable (3,6,7).

While allopathic medicine has not been very successful in treating laminitis, there is circumstantial evidence that acupuncture reduces patient’s lameness and suffering; however, evidenced-based scientific research is scarce (8). Acupuncture
has been widely used as a complementary treatment option in human and veterinary medicine to produce analgesic effects, normalize physiologic functions, and treat clinical disorders (9). Many recent studies have focused on the effect of acupuncture in treating various aspects of equine diseases such as musculoskeletal, gastrointestinal, respiratory, and reproductive disorders; nonetheless, there is a lack of evidence-based research supporting the efficacy of acupuncture in treating laminitis (6,8). The purpose of this study was to objectively evaluate the effect of acupuncture treatment on the lameness level in horses with chronic laminitis. It was hypothesized that acupuncture would reduce lameness severity in horses with chronic laminitis.

Materials and methods

Animals

Twelve adult horses [mean 16.9 y ± 5.7 y standard deviation (SD) old] with chronic laminitis from one geographical area were selected. Age, breed, gender, initial degree of lameness, and duration of lameness were recorded. All horses in this study had been suffering from chronic laminitis for several months. Referring veterinarians had confirmed a diagnosis via clinical examination and radiography more than a month before the study was performed. The etiology of laminitis was beyond the scope of this study but the owners suggested

Figure 1. Additional selected acupoints based on the results of diagnostic acupuncture palpation examination: ① Stomach-45, ② Gallbladder-44, ③ Bladder-67, ④ Bladder-25, ⑤ Bladder-26, ⑥ Bladder-27, and ⑦ BAI-HUI point.

Figure 2. Treatment formula. Hemo-acupuncture in dorsal region (left); from lateral (L) to medial (M): ① Small Intestine-1, ② QIAN-TI-TOU point, ③ Triple Heater-1, ④ QIAN-TI-TOU mirror point, and ⑤ Large Intestine-1. Dry needling in palmar region (right); from lateral (L) to medial (M), ⑥ Heart-9, ⑦ QIAN-TI-MEN point, ⑧ Pericardium-9, and ⑨ Lung-11.
metabolic disorder \((n = 2)\), nutrition \((n = 2)\), mechanical failure/improper shoeing \((n = 2)\), and unidentified reasons \((n = 6)\) as likely etiologies. The duration and cause of laminitis were not included in the analysis. A few horses were regularly receiving medications (e.g., Pergolide, Firocoxib) or supplements, and the owners were advised to maintain previous medicinal treatments during the study. Eight horses were using therapeutic shoeing; no further trimming/shoeing was advised during the study. This study was approved by the Institutional Animal Care and Use Committee and owners’ consent was obtained.

**Lameness evaluation**

An objective lameness evaluation was conducted using a wireless, body-mounted inertial gyroscope and accelerometer system called the “Lameness Locator” (Equinosis LLC, St. Louis, Missouri, USA). Three small wireless sensors were mounted on the horse’s body. One axial accelerometer was mounted on the head and one on the pelvis, while a single-axial gyroscope was placed on the dorsal aspect of the right front pastern. The wireless data from vertical acceleration of the head and pelvis and angular velocity of the right forelimb were collected using a laptop computer, analyzed, and reported as ‘Vector Sum.’ The Lameness Locator has been successfully used in previous studies to evaluate lameness in horses (10–12). In addition, lameness severity was evaluated using a routine visual lameness examination based on the American Association of Equine Practitioners (AAEP) recommended 0 to 5 grading system (13). Lameness examination was carried out before the first and 1 wk after the second acupuncture treatment. To ensure consistency and accuracy, the lameness evaluation was replicated 3 times for each horse and the arithmetic mean was calculated and used for statistical analyses.

**Acupuncture treatments**

A diagnostic acupuncture palpation examination was performed on all horses before each treatment and appropriate acupuncture points were selected and treated (Figure 1). Each horse received 2 treatments one week apart. The acupuncture treatments included dry needling, hemo-acupuncture, and aqua-acupuncture depending on the nature of the problem and the location of the acupuncture points treated. For consistency, hemo-acupuncture (Small Intestine-1, Triple Heater-1, Large Intestine-1, QIAN-TI-TOU, and QIAN-TI-TOU mirror points) and dry needling (Heart-9, Pericardium-9, Lung-11, and QIAN-TI-MEN points) were used as a basic treatment formula for all the horses in this study (Figure 2).

**Statistical analysis**

All statistical analyses were conducted using SAS software for Windows version 9.3 (SAS Institute, Cary, North Carolina, USA). Descriptive statistics are presented as means and standard deviations for continuous variables. Data were not normally distributed; therefore, non-parametric analysis was required. Lameness severity from before the first and after the second acupuncture treatment was analyzed via Wilcoxon signed-rank test. All statistical tests were one-sided and \(P\)-values \(< 0.05\) were considered statistically significant.

**Results**

The severity and painfulness of the condition, and resultant lameness severity, varied among horses. Using the AAEP evaluation scale, lameness varied from 1 degree to 4 degrees before the treatment and 1 degree to 3.5 degrees after. The mean lameness severity, following AAEP grading, decreased 1 degree, from 3.27 degrees at baseline to 2.27 degrees after the second acupuncture treatment. Results from the objective lameness evaluation using the Lameness Locator (LL) were consistent with AAEP grading. Results from both visual lameness evaluation \((P = 0.0039)\) and LL \((P = 0.0269)\) showed a significant reduction in lameness severity between these 2 time periods (Figure 3).

**Discussion**

Due to limited research studies and a growing interest in holistic medicine from both clinicians and clients, there is a need for advancing evidentiary research in veterinary acupuncture (14).
Our results support the anecdotal evidence that acupuncture can alleviate the level of lameness and pain in horses with chronic laminitis.

The treatment of chronic laminitis varies with the severity of clinical signs and response to treatment. Overall, the goal is to treat the underlying disease, if applicable, decrease the pain and lameness with medications [e.g., non-steroidal anti-inflammatory drugs (NSAIDs)], and reduce stress of the lamellar junction (e.g., modifying hoof biomechanics by therapeutic trimming/shoeing) (1). Nonetheless, the treatment plan may not be successful; it has been reported that 67% of laminitic horses suffering from persistent lameness were eventually euthanized (3). While current treatment options are limited, and at times unsuccessful, acupuncture has been successfully implemented in a gradually increasing number of cases. Acupuncture provides a drug-free and safe alternative treatment with minimum side effects and rare adverse reactions (15,16).

Acupuncture influences multiple organs and tissues which are commonly involved in the development of laminitis, such as the musculoskeletal, gastrointestinal, and immune systems (17). It has been suggested that acupuncture prevents and modifies the perception of pain at many different levels of the nervous system including an increase in opioid peptides secretion, oxytocin concentration, and activation of serotonin receptors (18–21). Acupuncture may also increase nitric oxide (NO) synthase activity around meridians and acupoints (22). It has been reported that NO is a key regulator of local circulation and may improve the second treatment. Further research is needed to determine the optimum number and frequency of acupuncture treatments to achieve the maximum benefit for this condition, as well as how long the therapeutic effects of the acupuncture continue after the last treatment. Future studies should include a focus on treatment effect in relation to causative factors as this study did not differentiate among laminitis etiologies. Due to the limited number of available horses for the study, it was not feasible to include a control group and maintain the required power for statistical analysis. Investigation into acupuncture treatments involving a robust control group will also illuminate important aspects of this procedure.

Pain control in horses with chronic laminitis is critical for prognosis and rehabilitation. The results of this study provide objective evidence that acupuncture treatment reduces the severity of lameness in horses with chronic laminitis; consequently, acupuncture could be considered along with other treatment options in horses suffering from chronic laminitis.

Acknowledgments

This study was supported by the American Holistic Veterinary Medicine Foundation, the National Research Foundation of Korea (NRF), Ministry of Education (2015R1A6A3A03016859), and Western University of Health Sciences, College of Veterinary Medicine.

References


Animal Health Information Sources

Below is a list of several links to Canadian sources of information on animal health and disease. Our goal is to provide current information while not duplicating existing efforts. We hope that this contact information will be of assistance to veterinarians across the country.

1. Canadian Animal Health Coalition (CAHC/CCSA) newsletter
   http://service.meltwaternews.com/mnews-ws/resources/pastnewsletter/latestHtml?n=MTUwNTUz&r=MTUyNzQz

2. Alberta Animal Health Source (ABVMA) site:
   http://www.albertanimalhealthsource.ca/

3. Animal Health Laboratory — University of Guelph
   http://www.guelphlabservices.com/ahl/

   http://www2.gov.bc.ca/gov/content/industry/agriculture-seafood/animals-and-crops/animal-health/animal-health-centre/newsletter

5. Prairie Diagnostic Services Inc. (Animal Health Perspectives newsletter)
   http://pdslnc.ca/


7. University of PEI — Diagnostic Services (Newsletter)
   http://www.upei.ca/avc/diagnostic-services/newsletters
Article

Flock-level prevalence, geographical distribution, and seasonal variation of avian reovirus among broiler flocks in Ontario

Eric G. Nham, David L. Pearl, Durda Slavic, Rachel Ouckama, Davor Ojkic, Michele T. Guerin

Abstract — Avian reovirus (ARV) is an economically significant pathogen of broiler chickens. Our objective was to determine the prevalence, geographical distribution, and seasonal variation of ARV infection among commercial broiler flocks in Ontario, Canada during grow-out. A cross-sectional study of 231 randomly selected flocks was conducted from July 2010 to January 2012. Fifteen blood samples, 15 whole intestines, and 15 cloacal swabs per flock were collected at slaughter; ELISA and PCR were used to determine a flock’s ARV exposure status. Avian reovirus prevalence was 91% (95% CI: 87 to 94). District alone did not significantly explain the overall variation in the prevalence of ARV (univariable logistic regression; \( P = 0.073 \)), although geographical differences were identified. The odds of ARV presence were significantly lower in the summer/autumn compared to the winter/spring (univariable exact logistic regression; \( P < 0.001 \)). There was no association between flock mortality and flock ELISA mean titer or PCR status.

Résumé — Prévalence au niveau du troupeau, distribution géographique et variations saisonnières du réovirus aviaire parmi les troupeaux de poulets à griller en Ontario. Le réovirus aviaire (RVA) est un agent pathogène important sur le plan économique pour les poulets à griller. Notre objectif consistait à déterminer la prévalence, la distribution géographique et les variations saisonnières de l’infection par le RVA parmi les troupeaux de poulets à griller commerciaux en Ontario, au Canada, durant la phase d’engraissement. Une étude transversale de 231 troupeaux choisis au hasard a été réalisée de juillet 2010 à janvier 2012. Quinze échantillons sanguins, 15 intestins complets et 15 écouvillons cloacaux ont été prélevés à l’abattage; des tests ELISA et ACP ont été utilisés pour déterminer l’état d’exposition du troupeau au RVA. La prévalence du réovirus aviaire était de 91 % (IC de 95 % : de 87 à 94). Le district à lui seul ne peut pas expliquer significativement la variation générale dans la prévalence du RVA (régression logistique univariable; \( P = 0,073 \)), quoique des différences géographiques ont été identifiées. Les risques de la présence du RVA étaient significativement inférieurs à l’été/automne comparativement à l’hiver/printemps (régression logistique exacte univariable; \( P < 0,001 \)). Il n’y avait aucune association entre la mortalité du troupeau et le titre moyen ELISA du troupeau ou de son état d’ACP.

Can Vet J 2017;58:828–834

Introduction

Avian reoviruses (ARVs) are members of the Orthoreovirus genus in the family Reoviridae. Avian reoviruses are associated with various diseases in chickens, such as respiratory and enteric disease, hydropericardium, pericarditis, myocarditis, and hepatitis (1). However, the most recognized form of ARV-associated diseases, and also a significant cause of lameness, is tenosynovitis (1).

Tenosynovitis, also known as viral arthritis, is predominantly a problem in broiler chickens, and results in swelling of the hock joint(s). Depending on the severity of the inflammation, affected birds are unable to move toward feed and water resulting in poor growth, culling, or death. Birds that survive to slaughter may be downgraded because of inflamed hock joints. This is a serious economic concern for broiler producers due to the costs associated with feed, labor, and lost production.

Avian reovirus infection in broiler chicken flocks appears to be high. Owoade et al (2) reported a seroprevalence of 41.0% among Nigerian broiler flocks, whereas studies conducted in Iran (3), Turkey (4), and Romania (5) reported higher

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seroprevalences (70.6% to 98.3%). At present, there is insufficient information on the prevalence or distribution of ARV in the Ontario broiler industry. An understanding of the baseline prevalence is the first step toward developing disease control strategies and determining the effectiveness of current biosecurity and management practices on the risk of ARV infection. Thus, the objectives of this study were to establish the baseline flock-level prevalence, geographical distribution, and seasonal variation of ARV among commercial broiler chicken flocks in Ontario during the grow-out period.

**Materials and methods**

**Sampling**

This study was part of a larger project designed to estimate the flock-level prevalence and risk factors for 13 pathogens of poultry health significance in the Ontario broiler industry. The sampling frame was all broiler producers in Ontario who were contracted with 6 major processing plants (5 federal and 1 provincial). These plants represent approximately 70% of broiler chickens processed in the province. Sample size estimates were based on identifying risk factors. Thus, using 95% confidence, 80% power, and a difference of 20% between the proportions of exposed and unexposed flocks with an estimated baseline flock-level prevalence of 20%, the target sample size to simultaneously evaluate multiple risk factors was 240 flocks. Our estimated baseline prevalence is lower than that of ARV studies conducted elsewhere (41% to 98%) (2–5); however, because we were estimating the flock-level prevalence of 13 pathogens, we chose a single, relatively conservative value of 20% for all pathogens. Approximately equal numbers of randomly selected flocks were enrolled every 4 wk during the sampling period (July 2010 to January 2012) to account for potential seasonal variation in pathogen prevalence. The number of flocks sampled from each processing plant was proportional to the plant’s market share of Ontario’s broiler processing. The days on which each plant was visited during each 4-week period were randomized using MiniTab 14 statistical software (Minitab, State College, Pennsylvania, USA). For each sampling day, 1 flock was randomly selected using numbered coins from the list of flocks scheduled to be slaughtered that day, and the corresponding producer was phoned and invited to participate in the study. The number of flocks sampled per farm was limited to 1; if > 1 flock was selected from the same farm, only the first flock was considered for inclusion in the study. Flocks originating from Quebec were excluded from the study.

The number of samples required per flock to detect ARV within the flock was determined using the formula \( n = \ln x / \ln q \) (6), with an a priori within-flock prevalence estimate of 15% and a confidence level of 90%. This a priori estimate was deemed sufficient to detect all pathogens of interest in the context of the larger project. At the processing plants, 15 blood samples, 15 cloacal swabs pooled into 3 samples (5 swabs per sample), and 15 whole intestines (duodenum to cloaca) were collected conveniently from each flock. Each blood sample contained blood from 1 or more birds depending on the line-speed and set-up of the plant. If a flock was shipped by more than 1 truck, the number of samples collected from each truckload of birds was approximately equal. For example, if 5 trucks were used to ship a flock, 3 samples were collected from each truckload of birds to ensure representative sampling of the flock.

### Table 1. Primer and probe sequences

<table>
<thead>
<tr>
<th>Oligo name</th>
<th>Sequence 5’-3’</th>
<th>Final concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>AReoV_For_111027</td>
<td>AGCGTGCACAGCGCAAT</td>
<td>0.25 ( \mu M )</td>
</tr>
<tr>
<td>AReoV_Pr_111027</td>
<td>GGAGGTAGTGCGCMAACTTT</td>
<td>0.50 ( \mu M )</td>
</tr>
<tr>
<td>AReoV_Rev_111027</td>
<td>TGTWATCCCTCAACRAMGAGTG</td>
<td>0.25 ( \mu M )</td>
</tr>
</tbody>
</table>

### Table 2. Criteria used to classify commercial broiler chicken flocks sampled at processing between July 2010 and January 2012 in Ontario, Canada, as positive or negative for avian reovirus (ARV) based on enzyme-linked immunosorbent assay (ELISA) and polymerase chain reaction (PCR) results, and the number and percentage of flocks per criterion (\( n = 231 \) flocks)

<table>
<thead>
<tr>
<th>Mean titer</th>
<th>ELISA+</th>
<th>PCR positive</th>
<th>PCR negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 396</td>
<td>Flock ARV positive</td>
<td>76 (32.9%)</td>
<td>70 (30.3%)</td>
</tr>
<tr>
<td>396 - 999</td>
<td>Flock ARV positive</td>
<td>31 (13.4%)</td>
<td>19 (8.2%)</td>
</tr>
<tr>
<td>&lt; 10%</td>
<td>Flock ARV positive</td>
<td>13 (5.6%)</td>
<td>22 (9.5%)</td>
</tr>
</tbody>
</table>

a The cut-point used for the ELISA mean titer was that specified in the IDEXX reference guide (IDEXX Laboratories, Westbrook, Maine, USA).
b The total number of samples tested per flock using PCR was 6 (3 pooled samples of cecal tonsil tissues and 3 pooled samples of cloacal swabs); if \( n = 1 \) of 6 samples tested positive, the flock was considered to be PCR-positive.

c At least 10% of the blood samples were in profile group 1 (titers of 397 to 999) or higher. Profile groups are based on titer levels; as the level of antibody titer in a sample increases, the group number increases. The profile groups for this test range from 0 to 18 (Appendix 1). 

d The percentage of blood samples in profile group 1 or higher was less than 10%.
Table 3. Number of commercial broiler chicken flocks sampled at processing between July 2010 and January 2012 in Ontario, Canada stratified by enzyme-linked immunosorbent assay (ELISA) and polymerase chain reaction (PCR) test results for avian reovirus (n = 231 flocks); the average flock mortality per stratum is provided.

<table>
<thead>
<tr>
<th>ELISA mean titer</th>
<th>PCR positive</th>
<th>Average (range) flock mortality (%)</th>
<th>PCR negative</th>
<th>Average (range) flock mortality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5000 to 5999</td>
<td>2</td>
<td>3.1</td>
<td>0</td>
<td>—</td>
</tr>
<tr>
<td>4000 to 4999</td>
<td>2</td>
<td>3.2 (0.8 to 5.7)</td>
<td>0</td>
<td>—</td>
</tr>
<tr>
<td>3000 to 3999</td>
<td>2</td>
<td>3.0 (2.4 to 3.5)</td>
<td>2</td>
<td>3.0 (2.9 to 3.2)</td>
</tr>
<tr>
<td>2000 to 2999</td>
<td>8</td>
<td>3.9 (2.3 to 7.6)</td>
<td>5</td>
<td>4.8 (2.2 to 9.4)</td>
</tr>
<tr>
<td>1000 to 1999</td>
<td>18</td>
<td>3.6 (0.3 to 6.3)</td>
<td>22</td>
<td>3.5 (1.7 to 6.4)</td>
</tr>
<tr>
<td>500 to 999</td>
<td>31</td>
<td>3.6 (0.6 to 5.8)</td>
<td>26</td>
<td>3.6 (1.3 to 7.6)</td>
</tr>
<tr>
<td>397 to 499</td>
<td>14</td>
<td>3.3 (0.8 to 8.9)</td>
<td>15</td>
<td>4.4 (2.1 to 6.4)</td>
</tr>
<tr>
<td>0 to 396</td>
<td>44</td>
<td>3.2 (1.9 to 5.5)</td>
<td>41</td>
<td>3.4 (0.6 to 12.7)</td>
</tr>
</tbody>
</table>

* For each flock, mortality was estimated as the number of chicks placed minus the number of birds shipped, divided by the number of chicks placed, and multiplied by 100. For each stratum, average mortality was calculated as the sum of flock mortality in the stratum divided by the number of flocks in the stratum.

† The total number of samples tested per flock using PCR was 6 (3 pooled samples of cecal tonsil tissues and 3 pooled samples of cloacal swabs); if ≥ 1 of 6 samples tested positive, the flock was considered to be PCR-positive.

Due to missing mortality data the number of flocks used for the calculations were: a 16 of 18, b 23 of 31, c 11 of 14, d 3 of 8, e 18 of 22, f 25 of 26, g 14 of 15, h 14 of 15, i 38 of 41.

Sample processing
Samples were transported in coolers with ice packs to the Animal Health Laboratory, Guelph, Ontario. The samples were then further processed before submission for laboratory testing: for cecal tonsil tissue samples, 3 pools of 5 cecal tonsil tissues were collected from whole intestines. Instruments were autoclaved between flocks.

Enzyme-linked immunosorbent assay (ELISA)
A commercial ELISA kit (IDEXXX Laboratories, Westbrook, Maine, USA) was used to detect ARV antibodies in 15 serum samples. Samples were diluted 1 in 500 in the sample diluent buffer provided by the manufacturer. A 100-µL volume of diluted sample was added to the wells of the ELISA microplate and incubated for 30 min at room temperature. The liquid content of the wells was then removed and each well was washed 5 times with 300 µL of distilled water. A 100-µL volume of (goat) anti-chicken horseradish peroxidase conjugate was then dispensed into each well and incubated for 30 min at room temperature. The liquid content of the wells was then removed and each well was washed 5 times with 300 µL of distilled water. A 100-µL volume of 3,3′,5,5′-tetramethylbenzidine substrate solution was added and incubated for 15 min at room temperature. After incubation, 100 µL of “Stop Solution” was dispensed to stop the reaction and absorbance values were then measured at 650 nm.

Virus isolation
Three pools of cloacal swabs and 3 pools of cecal tonsils were used for virus isolation in cell culture to detect viral shedding and persistence, respectively. Virus isolation was conducted in Leghorn male hepatoma cells obtained from American Type Culture Collection (ATCC#CRL-2117). The cells were propagated in Dulbecco’s Modified Eagle’s Medium -F12 supplemented with 5% fetal bovine serum, 2 mM L-glutamine, 100 units/mL penicillin, and 100 mg/mL streptomycin (Gibco, Carlsbad, California, USA). Cells were monitored daily for the appearance of syncytia suggestive of reovirus replication and 1 additional blind passage was carried out.

Polymerase chain reaction (PCR)
Polymerase chain reaction was carried out on cell culture fluids after the second passage. Total nucleic acids for ARV-specific real-time PCR were extracted using MagMAX-96 Viral RNA Isolation Kit in a MagMAX Express-96 Magnetic Particle Processor (Applied Biosystems, Foster City, California, USA) according to the manufacturer’s instructions. Viral RNA was detected using a real-time PCR assay with primers and a probe designed to amplify a conserved 63 bp fragment of reovirus S3 segment (Table 1a); the test does not differentiate between “pathogenic” and “non-pathogenic” strains. The PCR amplification was carried out in 25 µL reactions in a LightCycler 480 Real-Time PCR System (Roche, Laval, Quebec) using AgPath-ID One-Step RT-PCR Kit (Applied Biosystems) under standard conditions (Table 1b).

Data analysis
The total number of samples tested per flock using PCR was 6 (3 pooled samples of cecal tonsil tissues and 3 pooled samples of cloacal swabs); if ≥ 1 of 6 samples tested positive, the flock was considered to be PCR-positive. Criteria used to classify flocks as positive or negative for ARV based on ELISA and PCR results are shown in Table 2. For ELISA mean titers, the cut-point used (396) was that specified in the IDEXX reference guide. Titer groups provided by IDEXX are shown in Appendix 1. Flocks were further stratified by ELISA and PCR test results and the average flock mortality per stratum was estimated (Table 3). For each flock, mortality was calculated as the number of chicks placed minus the number of birds shipped, divided by the number of chicks placed, and multiplied by 100. For each stratum, average mortality was calculated as the sum of flock mortality in the stratum divided by the number of flocks in the stratum. A bi-variable linear regression model was used to determine if there was an association between flock mortality (dependent...
Table 4. Final regression models for the associations between flock mortality and flock avian reovirus (ARV) ELISA\(^a\) and PCR\(^b\) test results (linear), ARV presence and season of grow-out (exact logistic), and ARV presence and district of grow-out (logistic), in commercial broiler chicken flocks in Ontario

<p>| Linear regression: flock mortality and flock ARV ELISA and PCR test results (n = 198 flocks) |  |</p>
<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>95% CI of coefficient</th>
<th>P-value (t-test)</th>
<th>P-value (partial F-test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flock ELISA mean titer</td>
<td>5000 to 5999</td>
<td>2.70</td>
<td>(−0.60, 6.00)</td>
<td>0.108</td>
</tr>
<tr>
<td>4000 to 4999</td>
<td>0.96</td>
<td>(−1.39, 3.30)</td>
<td>0.421</td>
<td>0.718</td>
</tr>
<tr>
<td>3000 to 3999</td>
<td>0.34</td>
<td>(−1.34, 2.02)</td>
<td>0.687</td>
<td>0.534</td>
</tr>
<tr>
<td>2000 to 2999</td>
<td>−0.21</td>
<td>(−1.23, 0.81)</td>
<td>0.686</td>
<td>0.611</td>
</tr>
<tr>
<td>1000 to 1999</td>
<td>0.09</td>
<td>(−0.59, 0.77)</td>
<td>0.794</td>
<td>0.716</td>
</tr>
<tr>
<td>500 to 999</td>
<td>0.11</td>
<td>(−0.50, 0.73)</td>
<td>0.716</td>
<td>0.716</td>
</tr>
<tr>
<td>397 to 499</td>
<td>−0.38</td>
<td>(−1.15, 0.39)</td>
<td>0.334</td>
<td>0.334</td>
</tr>
<tr>
<td>0 to 396</td>
<td>Referent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flock positive to ARV on PCR(^c)</td>
<td>Yes</td>
<td>−0.16</td>
<td>(−0.63, 0.32)</td>
<td>0.519</td>
</tr>
<tr>
<td>No</td>
<td>Referent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>3.62</td>
<td>(3.15, 4.10)</td>
<td>&lt; 0.001</td>
<td>0.0002</td>
</tr>
</tbody>
</table>

Exact logistic regression: ARV presence and season (n = 227 flocks)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds ratio(^d)</th>
<th>95% CI of OR (exact)</th>
<th>P-value (exact)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Season</td>
<td>Winter and spring</td>
<td>17.53</td>
<td>(2.98, +∞)</td>
</tr>
<tr>
<td>Summer and autumn</td>
<td>Referent</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Logistic regression: ARV presence and district (n = 231 flocks)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds ratio</th>
<th>Coefficient</th>
<th>95% CI of coefficient</th>
<th>P-value (Wald’s test)</th>
<th>P-value (Likelihood ratio test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>District(^e)</td>
<td>District 1</td>
<td>0.08</td>
<td>−2.54</td>
<td>(−4.87, −0.22)</td>
<td>0.032</td>
</tr>
<tr>
<td>District 3</td>
<td>0.09</td>
<td>−2.43</td>
<td>(−4.58, −0.28)</td>
<td>0.027</td>
<td>0.027</td>
</tr>
<tr>
<td>District 4</td>
<td>0.07</td>
<td>−2.60</td>
<td>(−4.93, −0.28)</td>
<td>0.028</td>
<td>0.028</td>
</tr>
<tr>
<td>District 5</td>
<td>0.06</td>
<td>−2.89</td>
<td>(−5.23, −0.55)</td>
<td>0.016</td>
<td>0.016</td>
</tr>
<tr>
<td>District 6</td>
<td>0.11</td>
<td>−2.20</td>
<td>(−5.06, 0.70)</td>
<td>0.133</td>
<td>0.133</td>
</tr>
<tr>
<td>District 7</td>
<td>0.19</td>
<td>−1.64</td>
<td>(−4.08, 0.80)</td>
<td>0.188</td>
<td>0.188</td>
</tr>
<tr>
<td>District 9</td>
<td>0.08</td>
<td>−2.48</td>
<td>(−4.80, −0.16)</td>
<td>0.036</td>
<td>0.036</td>
</tr>
<tr>
<td>District 2 + 8</td>
<td>Referent</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>4.28</td>
<td>(2.30, 6.25)</td>
<td>&lt; 0.001</td>
<td>0.0001</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) ELISA = enzyme-linked immunosorbent assay.

\(^b\) PCR = polymerase chain reaction.

\(^c\) At least 1 of 6 pooled cecal tonsil tissue or pooled cloacal swab samples tested positive to ARV on PCR.

\(^d\) Median unbiased estimate.

\(^e\) The Chicken Farmers of Ontario, a producer-run, non-profit organization representing registered Ontario chicken producers, partitions Ontario into 9 administrative/geographical areas referred to as broiler districts. Districts 2 and 8 were chosen as the referent because the highest prevalence was observed in these districts.

variable) and flock ELISA mean titer (categorical) and flock PCR status (dichotomous) (Table 3); model assumptions of normality and homoscedasticity were evaluated visually using a normal quantile plot and a plot of the standardized residuals against the predicted outcome, respectively.

To explore potential seasonal variation in ARV prevalence, each flock was categorized into 1 of 4 seasons (summer = June 21 to September 20; autumn = September 21 to December 20; winter = December 21 to March 20; spring = March 21 to June 20). For example, a flock was considered to have been raised in the summer if the half age of the flock (19 d on average in the study population) was before the first calendar day of autumn. Half age of the flock was chosen because broiler breeders in Ontario are vaccinated against ARV, and maternal immunity is expected to decrease after approximately 14 d of age, leaving the chicks vulnerable to infection if exposed to the virus. Of 231 flocks, 4 were excluded from the seasonal analysis due to incomplete data on age at processing. For each season, prevalence was calculated as the number of flocks that were positive for ARV during the season divided by the number of flocks sampled during the season. Initially, a univariable logistic regression model was used to determine if there were statistically significant differences in prevalence between seasons. However, a model using season as a categorical independent variable could not be built due to perfect prediction (100% prevalence of ARV in the winter and spring). Season was therefore re-categorized into a dichotomous variable; winter and spring were collapsed into 1 category, and summer and autumn, which had similar
prevalence, were collapsed into another category (the referent category), and the 2 categories were compared using a univariable exact logistic regression model.

For each broiler district (administrative area), prevalence was calculated as the number of flocks that were positive for ARV in the district divided by the number of flocks sampled in the district. A choropleth map of the geographical distribution of ARV prevalence in Ontario was created using ArcGIS 10.4 (Esri, Redlands, California, USA). A reference map of Ontario’s 9 broiler districts was obtained from the Chicken Farmers of Ontario (CFO; Ontario’s chicken marketing board) and used to create the prevalence map; a manual classification method was used to create prevalence classes with ranges of equal size in ArcMap (ArcGIS 10.4; Esri, Redlands, California, USA). This method was selected because of the very high prevalence and relatively low variation of ARV across the province coupled with the uneven distribution of flocks per district. A univariable logistic regression model was used to determine if there were statistically significant differences in prevalence between districts. However, a model using district as a categorical independent variable (districts 1 through 9) could not be developed because district 8, which had a prevalence of 100%, dropped out of the model due to perfect prediction. Therefore, districts 8 and 2 (second highest prevalence and adjacent to district 8) were combined and used as the category to which all other districts were compared. A Hosmer-Lemeshow test was used to test the fit of the model, with \( P \leq 0.05 \) indicating a lack of fit. A Hosmer-Lemeshow test was chosen because the Pearson Chi-squared goodness-of-fit test could not estimate the test statistic, most likely due to a low number of data points for some covariate patterns. All statistical analyses (\( \alpha = 0.05 \), 2-tailed) were performed using Stata Intercooled version 13 (StataCorp, College Station, Texas, USA).

Results

In total, 231 flocks were sampled between July 2010 and January 2012. One flock had 16 blood samples collected, 2 flocks had 10 blood samples collected, 11 had 14 collected, and the remainder (217, 93.9%) had 15 blood samples collected.

Characteristics of the study population

Four producers who allowed sample collection at the processing plant did not complete an interview. Consequently, farm/flock-level data were available for 227 flocks. None of the study flocks were vaccinated for ARV during the grow-out period. The mean and median weight of birds at processing was 2.2 kg (range: 1.7 to 3.1 kg). The median flock age at shipment was 38 d (range: 31 to 53 d). The mean mortality per flock was 3.5% (range: 0.3% to 12.7%); this included both natural death and culling. The median flock size was 25,092 birds (range: 7,242 to 104,040 birds; flock size was available for 200 flocks). The number of flocks raised using an all-in-all-out system of production at the flock level (i.e., all birds within a flock were placed on the same date and also shipped for processing simultaneously) was 223 of 231 flocks (98.2%). The number of barns in which the flock was raised varied: 1 barn (168/227 flocks; 74.0%), 2 barns (46/227 flocks; 20.3%), 3 barns (8/227 flocks; 3.5%), or 4 barns (5/227 flocks; 2.2%).

Avian reovirus prevalence

In total, 117 of 692 cloacal swabs (16.9%) and 169 of 691 cecal tonsils (24.5%) were positive for ARV on real-time PCR, and 1,756 of 3,445 blood samples (51.0%) were in profile group 1 (titers of 397 to 999) or higher. Overall, 209 of 231 flocks (90.5%, 95% CI: 86.8 to 94.3) were positive for ARV. The number and percentage of flocks per classification criterion are shown in Table 2. The ELISA mean titers ranged from 1 to 5,222; 120 flocks (51.9%) tested positive and 111 flocks (48.1%) tested negative on PCR (Table 3). The average flock mortality stratified by ELISA mean titer and PCR status ranged from 3.0% to 4.8% (Table 3); the stratum-specific ranges were variable in both the PCR-positive and -negative groups, with very high flock-level mortality on some farms. There was no association between flock mortality, and flock ELISA and PCR results (Table 4), and the assumptions of linear regression were met.

The prevalence of ARV by season was 88.4% in the summer (61/69 flocks), 84.0% in the autumn (68/81), and 100% in the winter (48/48) and the spring (29/29). The results of the exact logistic regression showed that flocks raised in the winter and spring were at higher odds of testing positive for ARV compared with flocks raised in the summer and autumn [OR (median unbiased estimate) = 17.53, exact 95% CI: 2.98 to +∞, exact \( P = 0.0002 \); Table 4].

The prevalence of ARV by broiler district ranged from 80% (district 5) to 100% (district 8) (Table 5, Figure 1). District alone did not significantly explain the overall variation in the prevalence of ARV (LRT \( \chi^2 = 12.98, P = 0.073 \); Table 4); however, the odds of testing positive for ARV were lower for flocks raised in district 1 (OR = 0.08, P = 0.032), district 3 (OR = 0.09, P = 0.027), district 4 (OR = 0.07, P = 0.028), district 5 (OR = 0.06, P = 0.016), and district 9 (OR = 0.08, P = 0.036) compared to the districts with the highest prevalence (districts 8 and 2). The logistic regression model fit the data (Hosmer-Lemeshow \( \chi^2 = 0.00, P = 1.000 \)).

### Table 5. Flock-level avian reovirus prevalence among commercial broiler chicken flocks sampled at processing between July 2010 and January 2012 in Ontario, Canada by broiler district (\( n = 231 \) flocks)

<table>
<thead>
<tr>
<th>District</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>17/20(^a)</td>
<td>38/39</td>
<td>38/44</td>
<td>16/19</td>
<td>12/15</td>
<td>8/9</td>
<td>28/30</td>
<td>34/34</td>
<td>18/21</td>
<td></td>
</tr>
<tr>
<td>(85.0%)</td>
<td>(97.4%)</td>
<td>(86.4%)</td>
<td>(84.2%)</td>
<td>(80.0%)</td>
<td>(88.9%)</td>
<td>(93.3%)</td>
<td>(100%)</td>
<td>(85.7%)</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) The denominator indicates the number of flocks sampled per district.
Avian reovirus has been found on many poultry farms with chickens suffering from tenosynovitis, malabsorption syndrome, and enteric/respiratory diseases (1). These diseases result in significant economic losses; however, there is insufficient information on the prevalence and distribution of the virus in the commercial broiler population in Canada. This study captured the baseline prevalence of ARV among a large sample of randomly selected broiler flocks at processing in Ontario between July 2010 and January 2012. Although ARV infection was common (90.5%) among broiler flocks in Ontario, this was not synonymous with ARV-associated diseases. Our findings are similar to the reported prevalence in Iran (98.3%) (3), Romania (85.7%) (5), and 4 western provinces in Turkey (70.6% to 77.2%) (4), and higher than the prevalence reported in Nigeria (41.0%) (2). Notwithstanding, there were several aspects of study design/population that differed among these studies and our study, including the classification criteria used to determine flock status (positive/negative), antibody titer thresholds for reovirus seropositivity, the age of broilers at sampling, and vaccination of breeders, which make it difficult to compare findings. Most of these studies used only 1 test (i.e., ELISA) to determine the flocks’ ARV status (3–5). The mean titer threshold used in the Nigerian study was higher than in our study (1351 versus 396); the thresholds used in the Iranian and Romanian studies were not specified. Similar to our study, sampling in the Iranian study was conducted at the time of slaughter, although the age was not specified. In the Romanian study, samples were collected from 35-day-old broilers, which is in line with the average flock age of 38 d in our study. The study conducted in Nigeria sampled blood from 1-day-old to 8-week-old broilers. Furthermore, in contrast to our study, in which all domestic broiler breeder flocks are vaccinated for ARV several times as pullets, including at least 2 live vaccines and 2 killed vaccines, the parent flocks in the Iranian and Nigerian studies were not vaccinated against reovirus.

In our study population, the proportion of flocks that were PCR positive was approximately equal to the proportion that was PCR negative. Further, the distribution of ELISA mean titers was similar among the PCR-positive and PCR-negative flocks. Interpretation of the mean titer and PCR results could indicate when (early versus late) exposure likely occurred. For example, flocks with high mean titers were likely exposed to ARV earlier during the grow-out period, therefore had high antibody titers at the time of slaughter, yet may or may not have been shedding virus at that time. In contrast, PCR-positive flocks with low mean titers were likely exposed to ARV late in the grow-out period, and therefore had not mounted a full immune response at the time of slaughter, yet were shedding virus that could be detected on PCR. Such detail might be important when exploring associations between ARV exposure and production data.

Although several flocks in our study had high mean titers, approximately 3/4 had a mean titer < 1000. This is somewhat comparable to the geometric mean titers of ARV from serological samples from a small study in Romania (7 broiler farms), which ranged between 89 and 775 using IDEXX’s ELISA kit (5). It should be noted that the mean mortality in our study population was consistent with the provincial average; the CFO reported that the average mortality for the province between 2005 and 2009 was 4.0% (range: 3.6% to 6.1%) for all slaughter ages and weights. However, there was no statistically significant association between flock mortality and the flock’s ELISA mean titer and PCR status, suggesting that there was no direct relationship between the antibody titers and mortality in this baseline surveillance study. This finding might be related to a lack of differentiation between pathogenic and non-pathogenic strains. Conversely, because we could not differentiate between natural mortality and culling, mortality in our study might be a surrogate for poor management or heavy culling for ARV-associated diseases or other diseases, as suggested by the widely varied flock-level mortality in several of the low to mid-titer strata.

Randomization resulted in excellent representation of the distribution of broiler production in the province (7). The prevalence of ARV was very high across the province, and although overall, district was not a significant predictor of ARV presence, statistically significant differences in prevalence between districts were identified. The variation in the geographical distribution of ARV could be due to localized differences in risk factors, such as environmental challenges, the density of farms, early mortality associated with E. coli, or subtle differences in management and biosecurity practices among districts. The virus can survive under farm conditions for 12 to 15 wk — it is heat resistant, stable in a wide spectrum of pH (3.0 to 9.0), and resistant to disinfectants commonly used in poultry houses (8). This environmental resistance of the virus is likely one of the reasons for the high prevalence across the province.

To our knowledge, this is the first observational study that has investigated the seasonal variation in ARV prevalence. Avian reovirus was common in all seasons. Meulemanns and Halen (9) found that ARV was active at temperatures up to 50°C, indicating the hardiness of the virus. However, information on the seasonal adaptation of the virus to certain temperatures is unknown. We found that ARV was less prevalent in the summer and autumn compared to the winter and spring. It is possible that factors, such as cleaning and disinfection practices or

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**Figure 1.** Flock-level avian reovirus prevalence among commercial broiler chickens sampled at processing between July 2010 and January 2012 in Ontario, Canada by broiler district (n = 221 flocks). The map was produced using ArcGIS 10.4 (Esri, Redlands, California, USA).
ventilation, which vary among seasons, might have contributed to the minor seasonal variation in prevalence. In Ontario, the CFO’s On-Farm Food Safety Assurance Program dictates that broiler barns must be disinfected at least once per year (10). Given the climate in Ontario, it is possible that many producers carry out this task in the summer and early autumn when ambient temperatures are more favourable for thorough cleaning and disinfection (9).

Avian reovirus has been associated with several poultry diseases. However, the pathogenesis is unclear and its presentation is likely influenced by unknown factors. Commercial ELISA cannot distinguish pathogenic strains of reovirus from non-pathogenic strains (11); therefore, it is not known what percentage of flocks in our study was exposed to pathogenic strains. Given that ARVs are ubiquitous in domestic fowl, and that the majority of reoviruses isolated from poultry farms are non-pathogenic, it is likely that mainly non-pathogenic strains accounted for the high prevalence of ARV in broiler farms in Ontario. Notwithstanding, because there is considerable variation in virulence between antigenically similar isolates and there can be reassortment of genes when a cell is infected by more than one strain of ARV (12), the high prevalence is of concern because of the potential for the development of new, potentially pathogenic variants that can lead to clinical disease. Genotyping of isolates is warranted to identify pathogenic strains.

Our study findings indicate that ARV is common among commercial Ontario broiler flocks in all seasons and in all broiler districts. Investigation of associations between ARV and aspects of flock management, such as biosecurity and management practices is warranted, as is investigation of associations between ARV and flock production parameters.

Acknowledgments

We are grateful to Dr. Marina Brash, Elise Myers, Thelma Martinez, Heather McFarlane, Stephanie Wong, Veronique Gulde, Christian Sandrock, and Chanelle Taylor, as well as fellow graduate students Dr. Michael Eregae and Hind Kasab-Bachi, for their help during this project. The cooperation of the Chicken Farmers of Ontario, broiler producers, and broiler processing plants was much appreciated.

This project was funded by the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA)/University of Guelph Partnership, OMAFRA-University of Guelph Agreement through the Animal Health Strategic Investment (AHSI) fund managed by the Animal Health Laboratory of the University of Guelph, the Poultry Industry Council, and the Chicken Farmers of Ontario.

Appendix 1. Titer groups provided by IDEXX (IDEXX Laboratories, Westbrook, Maine, USA) for their enzyme-linked immunosorbent assay (ELISA)

<table>
<thead>
<tr>
<th>Avian reovirus</th>
<th>Titer 1: 397</th>
<th>Titer 10: 12 000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Titer 2: 1000</td>
<td>Titer 11: 14 000</td>
<td></td>
</tr>
<tr>
<td>Titer 3: 2000</td>
<td>Titer 12: 16 000</td>
<td></td>
</tr>
<tr>
<td>Titer 4: 3000</td>
<td>Titer 13: 18 000</td>
<td></td>
</tr>
<tr>
<td>Titer 5: 4000</td>
<td>Titer 14: 20 000</td>
<td></td>
</tr>
<tr>
<td>Titer 6: 5000</td>
<td>Titer 15: 22 000</td>
<td></td>
</tr>
<tr>
<td>Titer 7: 6000</td>
<td>Titer 16: 24 000</td>
<td></td>
</tr>
<tr>
<td>Titer 8: 8000</td>
<td>Titer 17: 28 000</td>
<td></td>
</tr>
<tr>
<td>Titer 9: 10 000</td>
<td>Titer 18: 32 000</td>
<td></td>
</tr>
</tbody>
</table>

References

Use of skin stretching techniques before bilateral caudal superficial epigastric axial flaps in a dog with severe burns

Michelle M. Zingel, Sherisse A. Sakals

Abstract — This report describes how 2 days of skin stretching facilitated a tension-free closure of single event bilateral caudal superficial epigastric flaps in a dog with severe hindquarter burns. Full healing at all surgical sites with only minor dehiscence and without further treatment or abnormalities of gait or coat regrowth was achieved.

Case description

A 2-year-old female standard poodle was referred to the Western College of Veterinary Medicine (WCVM) for reconstructive surgery following extensive full thickness burns. The dog was a passenger in a vehicle that was involved in an accident and subsequently caught fire. The dog sustained burn injuries to the caudal dorsum, inner thighs, buttocks, perineum, and vulva (Figure 1). The initial recovery was managed by the referring veterinarian, and included debridement of necrotic tissue, daily hydrotherapy treatments, and bandaging with grocery grade honey as the primary layer. Medications administered included a fentanyl patch (Duragesic; ALZA Corporation, Palo Alto, California, USA) 75 μg/h transdermally, amoxicillin/clavulanic acid (Clavaseptin; Vétoquinol, Lavaltrie, Quebec), 375 mg, PO, q12h, and enrofloxacin (Baytril; Bayer, Shawnee Mission, Kansas, USA), 450 mg, PO, q24h.

On presentation to WCVM, approximately 2 wk after the trauma, the dog was quiet, alert, and appeared comfortable. Physical examination revealed a stiff and short-strided hind limb gait, due to the contraction of wound margins. The patient was in thin body condition (body condition score 3/9), and had an estimated 20% loss of body weight since the trauma. Due to the wounds, her abdomen was not palpated for abnormalities. Blood glucose testing revealed a slight hypoglycemia [4.0 mmol/L; reference interval (RI): 4.4 to 7.2 mmol/L]. No other abnormalities were detected on physical and laboratory examination.

The burn wounds were most severe on the caudal hind limbs and perineum, where a full thickness skin defect extended over the entire inguinal area, inner and caudal thighs, extending dorsally to the tail base (Figure 1). The defect was almost symmetrical. A healthy granulation bed was present over this large wound, and no debridement was necessary. The tail had an exposed caudal vertebra at the distal end. Smaller wounds were noted on the upper eyelids, left upper and lower lip, dorsal left caudal thorax, and cranial abdomen. These areas also had a healthy granulation tissue covering, and no debridement was needed. Multiple small areas of flaking skin and small healing wounds with scabs were noted over the dog’s legs, trunk, neck, and face.

Bilateral caudal superficial epigastric flaps were planned to cover the major defect on the caudal hind limbs and inner thighs. Skin stretching was performed 2 d before the surgery using the technique described by Pavletic and Troudt (1) using Velcro (Velcro Canada, Brampton, Ontario) and cyanoacrylate (KrazyGlue; Westerville, Ohio, USA). To place the skin stretching materials, the patient was sedated using hydromorphone (Hydromorphone hydrochloride; Sandoz Canada, Boucherville, Quebec), 0.5 mg/kg body weight (BW), IV, dexmedetomidine (Dexdomitor; Zoetis, Kalamazoo, Michigan, USA), 0.0015 mg/kg BW, IV, and ketamine (Narketan; Vétoquinol, Lavaltrie, Quebec), 0.5 mg/kg BW, IV. The patient was clipped from the mid-sternum to the pubis, extending to the lateral abdomen and thorax. Velcro with hooks were adhered to the left lateral abdomen with KrazyGlue, while Velcro with loops were adhered to the right lateral abdomen. Once the KrazyGlue had dried, the hook side of the Velcro was stretched ventrally from the left lateral abdomen, and attached to the looped Velcro on
the right lateral abdomen (Figure 2). The Velcro distance was shortened every 8 h to continue stretching the skin. The skin was monitored for elasticity. After 48 h there was enough skin recruitment estimated to cover the defect.

The patient was premedicated with hydromorphone (Hydromorphone hydrochloride; Sandoz), 0.05 mg/kg BW, IV, and dexmedetomidine (Dexdomitor; Zoetis), 0.0015 mg/kg BW, IV. To induce anesthesia, ketamine (Narketan; Vétoquinol), 2.5 mg/kg BW, IV and diazepam (Diazepam; Sandoz), 0.25 mg/kg BW, IV were given. Anesthesia was maintained with 0.5% to 1.75% isoflurane (Pharmaceutical partners of Canada; Richmond Hill, Ontario) in 100% oxygen. Ten minutes into the anesthesia, a continuous rate infusion (CRI) of ketamine (Narketan; Vétoquinol), 10 µg/kg BW per hour and remifentanil (Teva Canada; Toronto, Ontario), 10 µg/kg BW per hour were added. An hour into anesthesia, a CRI of lidocaine (Lidocaine Hydrochloride; Pfizer Animal Health, Pfizer Canada, Kirkland, Quebec), 30 mg/kg BW/min lidocaine was started. At the same time, lidocaine (Lidocaine Hydrochloride; Pfizer Canada), 2 mg/kg BW, IV was given. Cefazolin (Cefazolin injection; Hospira, Lake Forrest, Illinois), 22 mg/kg BW, IV was given every 90 min during surgery. Two hours into anesthesia, nitrous oxide was added at a rate of 1.4 L/min. Due to mild hypotension (systolic blood pressure of 80 mmHg and mean arterial pressure of 60 mmHg), dobutamine (dobutamine injection; Hospira), 5 µg/kg BW per minute CRI was started, and a tetrastarch (Voluven; Fresenius Kabi Canada, Mississauga, Ontario) bolus of 5 mg/kg IV was administered over 6 min.

The patient was anesthetized, placed in dorsal recumbency, and prepared and draped for surgery using standard procedure. Bilateral island caudal superficial epigastric axial pattern flaps were developed (Figure 3). A ventral midline abdominal incision was made through the skin, extending from between the second and third nipples to caudal to the last nipple. The flap was undermined deep to the supramammarius muscle and superficial to the external abdominal oblique muscle in a caudal direction. Each flap was elevated and rotated 180° around the caudal aspect of the ipsilateral leg. The lateral margins of each of the 2 donor site sides were apposed at midline without tension to the level of the inguinal area using 2-0 polydioxanone (PDSII; Ethicon) in a simple interrupted pattern. The subcutaneous tissue was closed using 3-0 poliglecaprone 25 (Monocryl; Ethicon) in a simple continuous pattern and the same suture was used to close the skin in an intradermal pattern. The large granulation beds at the caudal aspects of the thighs and buttocks were freshened at the edges where epithelialization was evident. A bridging incision was made between the wound bed and the flap on each side. The flaps were positioned over the wound bed following the lateral edges, and then turned back cranially to cover the remainder of the medial aspects of the wound beds. The subcutaneous skin tissue was closed using 3-0 polydioxanone suture (PDSII; Ethicon) in a simple continuous pattern, and the skin was closed using 3-0 nylon suture (Ethilon; Ethicon) in a simple interrupted pattern. Active drains with vacuum bulbs (Jackson-Pratt Bulb; Cardinal Health, Waukegan, Illinois, USA) were placed on each side.

After surgery, the patient was administered fentanyl (fentanyl citrate; Sandoz) at 3 µg/kg BW per hour, IV, CRI, meloxicam (Metacam, Boeringer Ingelheim; St. Joseph, Missouri, USA), 0.1 mg/kg BW, SC, and ketamine (Narketan; Vétoquinol), 1 mg/kg BW, SC. The dog appeared comfortable and began standing and walking with a normal gait the morning after surgery. Three days after surgery, the patient began squatting normally to urinate and started sleeping in a dorsal position with legs extended. Together the drains produced 48 to 60 mL/d of clear serosanguinous fluid for 6 d after surgery. On the seventh day, fluid decreased to < 10 mL/day, and the drains were removed. Mild dehiscence of approximately 3 cm was noted on the caudal distal portion of each flap 2 d after surgery.

A second surgery was performed 5 d after the initial surgery to debride the tail tip and cover the exposed tail vertebra. At the same time, the 2 small areas of caudal distal flap dehiscence were closed. The patient was pre-medicated with dexmedetomidine (Dexdomitor; Zoetis), 0.002 mg/kg BW, IV, and hydromorphone (Hydromorphone hydrochloride; Sandoz), 0.05 mg/kg BW, IV. Heavy sedation was achieved with ketamine (Narketan; Vétoquinol), 0.5 mg/kg BW boluses, IV. A regional tail block was also given subcutaneously along the tail using 1 mL of bupivacaine (Bupivacaine HCl Injection 0.5%; Hospira). The tail tip wound was undermined cranially and advanced over the exposed bone. The subcutaneous tissue was closed using 3-0 poliglecaprone 25 (Monocryl; Ethicon) in a simple continuous pattern. The skin was closed using 3-0 nylon suture (Ethilon; Ethicon) in a simple interrupted pattern.

Eight days after surgery the incisions were 95% intact, with several areas of 5 mm length exposure of underlying granulation tissue. The patient was sent home 10 d after surgery with a normal gait, and her major burn wounds fully covered. No
further intervention was needed after suture removal. The patient fully healed at all the injury and surgical sites without further dehiscence. There were no gait abnormalities and a full coat of fur grew back in due course.

**Discussion**

Full thickness burns tend to heal slowly, by contraction and epithelialization, and patients are vulnerable to local and systemic infection due to skin necrosis (1). In the patient we describe, healing by contraction would have led to a gait disturbance and impaired ability to ambulate. Impairment of normal gait was noted when the patient arrived at WCVM, seemingly due to the beginning of contraction at the wound margins. The wounds would also have taken a long time to heal and would have resulted in coverage with fragile epithelium, if indeed coverage of the entire defect could be achieved at all. Wound closure options included skin grafts, advancement flaps, and axial pattern flaps. Axial pattern flaps were chosen in this case because of their robust nature and the availability of donor tissue for the flaps which could be used to cover the major defects present in this dog.

Axial pattern flaps, such as the caudal superficial epigastric flap, incorporate a direct cutaneous artery and vein, and thus supply blood to the subdermal plexus (2). The direct blood supply in an axial flap is advantageous over other reconstructive methods, because it leads to comparably higher skin survival rates (3). Experimental studies and clinical trials have shown that axial pattern flaps can be safely elevated and transferred in a single stage to close major defects in their general radius (2).

The axial pattern graft allows the closure of large defects while decreasing the time of open wound management (3).

In 1 retrospective study of 10 caudal superficial epigastric flaps, the mean area of flap survival was 99.96% (4). Small areas of necrosis occurred near the tip of the flap (0.4% of flap surface area), and around a stab incision that was used for an external skeletal fixator (4). Overall, the complications associated with the caudal superficial epigastric flaps were minor and successfully treated with conservative management (4). In another retrospective study of 73 cases of axial pattern flaps in dogs and cats, incisional dehiscence was the most common complication (5). Successful outcomes occurred in 93% of these cases, with approximately 1/3 of cases requiring a second procedure (5). The results in our patient were similar to these findings. Excellent flap survival was noted, with only minor dehiscence, estimated to be maximum 1% of the flap area. We attached the flaps to the recipient bed in a semicircular pattern, and the small area of dehiscence was where there was a confluence of the incision into 3 lines meeting at 1 point.

In order to stretch the skin for simultaneous bilateral flaps, the process of mechanical creep and stress relaxation were used. Mechanical creep is the use of tension applied to the skin over a period of time (6). As the dermal collagen fibers are stretched, they progressively align and compact in the direction of the stretching force (6). As the collagen fibers align, stress relaxation reduces the amount of force that is necessary to maintain a
given strength (6). By applying an appropriate amount of force, skin can be recruited and used to cover defects. Skin stretching technique options include external skin stretchers, surgically placed tissue expanders, and walking sutures. Complications of skin stretching can occur if there is continuous stretching beyond maximal mechanical creep. This can result in breakage of dermal collagen fibers and skin damage (7).

The technique we used in this patient was described by Pavletic (8). This technique was used to facilitate the closure of large wounds in several dogs and cats. Use of the technique has also been reported for successful closure of a large wound over the dorsum and flank in a rabbit (9). A recent paper evaluated the use of this technique on the extremities of dogs and found that it was not as amenable to successful closure of large wounds as it has been reported to be on the trunk of small animals (10).

External skin stretching was chosen in this case due to its ease of use, low cost, and to maintain comfort in this hyperesthetic dog. Tissue expanders would require an additional anesthetic event and surgical procedure, whereas skin stretching was achievable with 1 short sedation event (8). The skin stretching was accomplished without disturbance of the many smaller regional wounds in various stages of healing, which would make other methods of skin recruitment vulnerable to tissue compromise, and more painful. The hook side of 2-inch Velcro stripping was adhered to the skin on each side of the patient from the lateral thorax to the lateral flank. Strips of the loop side of the Velcro were then apposed to the hook stripping on one side, stretched under the abdomen and across to adhere to the hook stripping on the contralateral side. The tension was adjusted every 8 h to maintain tension as the skin progressively stretched and relaxed, loosening the overlying Velcro strips, in accordance with published guidelines described by Pavletic (6,8). After 48 h the patient was taken to surgery and the Velcro strips were removed.

Bilateral caudal superficial epigastric flaps without skin stretching has been described in the cat (11). Entire wound coverage was achieved within 1 surgery, with moderate edema and crusting after surgery (11). However, this difference in skin stretching is likely due to the vast difference between the availability of skin in the cat compared to that in most dogs.

Bilateral flaps were indicated in this dog because the wounds were large and almost symmetrical, covering most of the caudal buttock and upper thigh region on each side. Considering that standard poodles have little excess skin, and this dog was in lean body condition, skin stretching was used to decrease the tension that would occur at the donor sites with simultaneous bilateral development of caudal superficial epigastric flaps. In 1 case report, bilateral simultaneous caudal superficial epigastric flaps were raised in a dog and 90% coverage was achieved without the use of skin stretching (12). Considerable tension was noted at closure of the donor sites (12). Three months after surgery, the remainder of the defect was closed during a second surgery (12).

In our patient, the use of skin stretching was primarily intended to provide a tension-free donor site closure. However, an added advantage was expansion of the dimensions of the flaps themselves. It is possible that without this added dimension to the flaps a defect may have remained at the primary site. Skin stretching has been used for the primary purpose of expanding an axial pattern flap to cover a large defect (13) and it is likely that our patient benefitted from this effect as well.

Our patient healed fully at both the donor site and the primary defect site without further treatment. There was no further dehiscence, no gait deficits or abnormalities, and a full coat of fur regrew over all the injured areas and surgical sites. With the use of skin stretching, 100% wound coverage of extensive defects over the caudal thighs and buttocks was achieved in this patient in 1 surgical event. Postoperative complications were minor, and included small areas of dehiscence. With the use of skin stretching, bilateral caudal superficial epigastric flaps can be used in dogs to cover major wounds on the caudal thighs.

References

Meningeal dissemination of a pituitary carcinoma to the cauda equina in a dog

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Abstract — An 8-year-old spayed female border collie dog was diagnosed with an invasive pituitary macrotumor. Five months after radiation therapy, the patient developed paraparesis and lumbosacral pain. Necropsy revealed a pituitary carcinoma with cauda equina drop metastasis. In cases of pituitary masses, meningeal dissemination should be considered if neurologic status declines.

Résumé — Dissémination méningée d’un carcinome pituitaire à la queue de cheval chez un chien. Une chienne Border collie stérilisée âgée de 8 ans a été diagnostiquée avec une macrotumeur pituitaire invasive. Cinq mois après la radiothérapie, la patiente a développé la paraparésie et de la douleur lombo-sacrée. La nécropsie a révélé un carcinome pituitaire avec une métastase de la partie inférieure de la queue de cheval. Dans les cas des masses pituitaires, la dissémination méningée devrait être considérée s’il se produit un déclin de l’état neurologique.

Case description

Canine tumors of pituitary origin are classified based on size as either microtumors (measuring < 10 mm in diameter) or macrotumors (> 10 mm in diameter). Macro- and micro-tumors may be further subdivided into functional or non-functional groups based on secretory or hormonal activity. The majority of canine pituitary macrotumors are adenomas, resulting in neurologic signs caused by enlargement of the pituitary gland and involvement of surrounding structures (1).

Pituitary carcinomas, classified by the presence of metastatic lesions, are uncommon, making up only an estimated 6% of canine and 0.1% to 0.2% of human pituitary tumors (2,3). The estimate of 6% for canine pituitary carcinomas may be an over- or underestimate, as clinical signs of pituitary adenomas and carcinomas are similar and necropsy is required to differentiate between them. Most pituitary macrotumors are functional and actively secrete adrenocorticotropic hormone (ACTH), resulting in clinical signs of hyperadrenocorticism (4). As such, primary pituitary tumors may present with a wide range of clinical signs related to intracranial compressive lesions, hormonal imbalance, and/or metastatic disease.

An 8-year-old spayed female border collie dog was presented for evaluation of a right-sided facial nerve paralysis, weight loss, and generalized lethargy. Five months earlier, the patient had been evaluated for polyuria/polydipsia (PU/PD) by its primary care veterinarian and was diagnosed with presumptive central diabetes insipidus (CDI) based on a positive response to desmopressin (DDAVP). A low dose dexamethasone suppression (LDDS) test was performed and results were consistent with hyperadrenocorticism (baseline cortisol 176.6 mmol/L, 4-hour cortisol 135.2 mmol/L, 8-hour cortisol 74.5 mmol/L), although a false positive result due to non-adrenal illness could not be ruled out. An abdominal ultrasound examination revealed normal adrenal gland size bilaterally.

Neurologic examination findings consisted of right facial nerve paralysis. Magnetic resonance imaging (MRI; Signa Horizon 1.5 T, GE Medical Systems, Milwaukuee, Wisconsin, USA) of brain and cerebrospinal fluid (CSF) collection was conducted. The MRI revealed a round or oval, homogenously contrast enhancing mass in the pituitary gland (2.04 × 1.9 × 1.82 cm) consistent with a pituitary macrotumor. The mass compressed the third ventricle and interthalamic adhesion, and there were small regions consistent with intracranial compressive lesions, hormonal imbalance, and/or metastatic disease.

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radiation treatment planning. Intensity modulated radiation was delivered with a TomoTherapy Hi-Art unit (TomoTherapy, Madison, Wisconsin, USA). The dose prescribed was 50 Gy to 95% of the planning target volume (PTV) delivered in 20 daily fractions. Prednisone, 0.55 mg/kg body weight (BW), PO, q24h, was administered during treatment for perilesional edema.

Recheck examination 2 wk after the final dose of radiation therapy revealed slow hair regrowth in the area previously shaved for CSF collection and progressive skin irritation over the entire dorsal midline. A skin biopsy was obtained from the dorsum and histopathologic changes were consistent with calcinosis cutis with secondary pyoderma. The patient was presented for re-evaluation of suspected hyperadrenocorticism. An ACTH stimulation test was performed at the time of skin biopsy and results were considered borderline for hyperadrenocorticism [pre-cosyntropin cortisol: 88.3 mmol/L (RI: 27.6 to 138.0 mmol/L); 1 h post-cosyntropin: 549.0 (RI: 275.9 to 551.8 mmol/L)]. A recheck ACTH stimulation test 5 wk later was normal [pre-cosyntropin cortisol: 44.1 mmol/L (R: 27.6 to 138.0 mmol/L); 1 h post-cosyntropin: 397.3 mmol/L (RI: 275.9 to 551.8)]. In the 2 mo following the ACTH stimulation recheck, calcinosis cutis was reported to be resolving and the secondary pyoderma was responding to cefovecin sodium (Convenia; Zoetis, Parsippany, New Jersey, USA; 8 mg/kg BW, SC, once) and topical 2% chlorhexidine spray. Facial nerve paralysis was reported to have spontaneously resolved.

Six months after radiation treatment, the patient was presented for evaluation of worsening PU/PD, decreased appetite, reduced pelvic limb mobility, and lethargy. Orthopedic examination revealed findings consistent with a previously diagnosed cranial cruciate ligament rupture. Pain was elicited with mid and caudal lumbar palpation, proximal tail palpation, and dorsal tail extension. Neurologic examination revealed mild paraparesis, low tail carriage, delayed paw replacement test in the left pelvic limb, delayed paw replacement test in the left thoracic limb, incomplete withdrawal reflexes in both pelvic limbs, and absent cutaneous truncal reflex bilaterally. Pain was elicited on tail manipulation and lumbosacral spinal palpation. The owner elected humane euthanasia at this time.

A complete necropsy examination revealed an enlarged lumbar region revealed mild intervertebral disc space narrowing at L5/L6 with moderate spondylosis deformans and bilateral coxofemoral osteoarthritis. The patient was treated supportively with tramadol (Anneal Pharmaceuticals, Hauppauge, New York, USA), 2.8 mg/kg BW, PO, q8-12h, and gabapentin (Glenmark Pharmaceuticals, Mahwah, New Jersey, USA), 8.5 mg/kg BW, PO, q8-12h, for analgesia.

Three weeks later, the patient was presented for evaluation of right pelvic limb lameness, non-specific pain, and an acute decrease in appetite. Neurologic examination revealed obtundation with a normal cranial nerve examination, moderate ambulatory paraparesis, absent paw replacement test in the left pelvic limb, delayed paw replacement test in the left thoracic limb, incomplete withdrawal reflexes in both pelvic limbs, and absent cutaneous truncal reflex bilaterally. Pain was elicited on tail manipulation and lumbosacral spinal palpation. The owner elected humane euthanasia at this time.

A complete necropsy examination revealed an enlarged (2.0 × 1.2 × 2.0 cm), grey to white pituitary gland. Histologic examination of the pituitary gland mass revealed a poorly demarcated and non-encapsulated neoplasm that invaded and effaced the overlying hypothalamus and ventral thalamus (Figure 1). The mass was noted to have completely effaced the normal pituitary gland. The cells were of epithelial origin based on cellular morphology and were arranged as sheets, cords, and trabeculae. The mitotic rate was 21 per 10 high powered fields (100×). Examination of the adrenal glands revealed marked bilateral cortical hyperplasia. Gross evaluation of the liver revealed multifocal pinpoint to 1 cm, faintly demarcated masses that were most consistent with hepatomas based on

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**Figure 1.** Photomicrograph showing a cross section of the pituitary, H&E stain. Primary pituitary carcinoma displaying a sheet of polygonal neoplastic epithelial cells with marked anisocytosis and anisokaryosis and a single mitotic figure. There is moderate to abundant eosinophilic cytoplasm occasionally containing faint basophilic granules.

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**Figure 2.** Photomicrograph showing a cross section of the cauda equina, H&E stain. The epithelial population in the subarachnoid space is compressing the adjacent cauda equina nerves. There are extensive areas of hemorrhage within the compressive lesion.
histopathologic evaluation [composed of sheets of polygonal cells with distinct cell borders and zero mitotic figures per 10 high powered fields (100×)]. Other regions of hepatic tissue contained moderate to multifocal coalescing areas of hepatocellular glycogen accumulation. Within the lung tissue there was marked multifocal to coalescing alveolar and bronchiolar mineralization with interstitial and pleural fibrosis throughout. Mineralization, fibrosis, and osseous metaplasia were also detected in the deep dermal layer of the skin. Moderate adnexal and epidermal atrophy were noted. These findings were consistent with a functional pituitary pars distalis carcinoma.

There was a 2.2 × 0.6 × 0.4 cm, focal, white to red, moderately swollen area in the cauda equina. Histopathologic examination of this region showed a moderately well-demarcated neoplastic mass of epithelial origin identical to the neoplastic cells identified in the pituitary gland (Figure 2). This mass, located in the subarachnoid space (intradural-extraparenchymal), resulted in compression of the nerves of the cauda equina and multifocal axonal degeneration. Based on the findings, the diagnosis was metastatic pituitary carcinoma.

Discussion

This is the first reported case of a pituitary carcinoma with meningeal dissemination to the cauda equina in the dog. Although the patient was diagnosed with a large, invasive pituitary mass based on brain MRI, the presence of neoplastic dissemination resulting in cauda equina syndrome was not diagnosed until necropsy. This report serves to inform clinicians of the potential for meningeal dissemination of pituitary carcinoma resulting in worsening or progression of neurologic signs.

A diagnosis of pituitary carcinoma is supported in this case by the presence of high mitotic index, effacement of normal pituitary gland, invasion into normal brain tissue, and lumbosacral subarachnoid metastasis. Pituitary carcinoma has been reported in dogs; however, there are few reports of cerebrospinal and systemic metastasis (1,2,5). Meningeal dissemination is thought to be more likely than hematologic metastasis in this case due to the absence of neoplastic cells in the lungs and other organs that are commonly affected by hematologic metastasis. Although it is a less common mechanism of metastasis, tumor cells may be carried by the flow of CSF and distributed throughout the central nervous system. This process was reported in a canine choroid plexus tumor wherein neoplastic cells could be observed in cerebrospinal fluid samples (6). Similarly, meningeal dissemination was suspected as the cause of metastasis in 3 canine cases of noncontiguous, multifocal oligodendromas (7). One case of cauda equina metastasis from a primary functional pituitary mass was reported in a human patient, but to the authors’ knowledge this has not been reported in a canine patient (8). More commonly seen are reports of neoplastic metastasis to the pituitary gland originating from the pancreas, thyroid, or transmissible venereal tumor (9–11).

Meningeal dissemination of pituitary tumors may be correlated with surgical manipulation of the tumor by removal, resection, or debulking in humans (12). This poses the question as to whether radiation treatment creates a similar manipulation risk to neoplastic lesions in the CNS and may have contributed to dissemination in this patient. The proposed mechanism of meningeal dissemination in this case is seeding of tumor cells with the flow of CSF in the subarachnoid space. Dissemination due to radiation therapy is unlikely, as the tumor was not directly manipulated during treatment.

The presumptive central diabetes insipidus diagnosed may have been due to compression of the hypothalamus from the pituitary neoplasm and/or decreased secretion of antidiuretic hormone from the posterior pituitary. The low dose dexamethasone suppression test was consistent with hyperadrenocorticism (presumed pituitary-dependent) prior to the diagnosis and treatment of the pituitary mass. The patient was never treated with medications to reduce hypercortisolemia. The multiple normal ACTH stimulation tests following radiation therapy were thought to be either due to reduced ACTH secretion post-radiation therapy or a false negative result.

The ultimate cause of neurologic decline and death in this patient was related to signs associated both with the pituitary mass and the metastatic lesion to the cauda equina. Although rare, meningeal dissemination or metastasis of pituitary carcinoma should be considered in cases of spinal or neurologic signs seen without or in tandem with signs of endocrine dysfunction.

Acknowledgment

The authors acknowledge Dr. Tamara Chamberlin for her contribution to the manuscript.

References

Cecal entrapment within the epiploic foramen in a mare

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Abstract — An 11-year-old Thoroughbred mare with colic unresponsive to medical treatment underwent exploratory laparotomy. During surgery the cecum was found entrapped within the epiploic foramen from left to right. The entrapped cecum was reduced through the foramen by gentle traction. After reduction of the cecum, rupture of the portal vein was detected. Loss of a large amount of blood prompted euthanasia during surgery.

Résumé — Encapsulation du cæcum dans le foramen omental chez une jument. Une jument Thoroughbred âgée de 11 ans atteinte de coliques ne répondant pas au traitement médical a subi une laparatomie exploratoire. Durant la chirurgie, le cæcum a été trouvé encapsulé dans le foramen omental de gauche à droite. Le cæcum encapsulé a été réduit par le foramen à l’aide d’une légère traction. Après la réduction du cæcum, la rupture de la veine porte a été détectée. La perte d’une grande quantité de sang a entraîné l’euthanasie durant la chirurgie.

Can Vet J 2017;58:842-844

Several case reports, case series, and retrospective studies have reported on epiploic foramen entrapment (EFE), involving various portions of intestine. The articles, for the most part, describe small intestinal entrapment, but segments of large intestine have also been found within the epiploic foramen (EF). To the best of our knowledge cecal EFE has only been reported in a supplement to Scheidemann’s thesis from 1989 (1). The aim of the current case report is to present a rare condition, and to describe the diagnostic process, clinical manifestations, and postmortem findings.

Case description
An 11-year-old Thoroughbred mare had been exhibiting signs of colic 6 h before arrival at the equine hospital. Initial signs of colic were mild to moderate, and included anxiety, pawing, and getting up and down. At the farm the mare had received non-steroidal anti-inflammatory medication (Flunixin meglumine, Banamine; Akorn, Decatur, Illinois, USA), 1.1 mg/kg body weight (BW), IV at the first sign of colic. Although the mare improved for a short time, recurrence of signs prompted transport to our hospital.

Upon arrival the mare was in pain and it was difficult to carry out the admission examination. Her heart rate was increased (66 to 68 beats/min), mucous membranes were pink and moist, capillary refill time was < 2 s, and her temperature was 37.0°C. The mare passed mucus-covered manure. Lung sounds were normal, and the respiratory rate was slightly increased (20 breaths/min). A complete blood (cell) count (CBC) with standard chemistry revealed pre-renal azotemia and dehydration [packed cell volume (PCV) 45%, total protein (TP) 70 g/L, creatinine 221 μmol/L]. The mare was sedated with xylazine (Xylazine, AnaSed LA; MWI, Boise, Idaho, USA), 1.1 mg/kg BW, IV and Butorphanol (Torbugesic; Pfizer, New York, New York, USA), 0.05 mg/kg BW, IV to allow further examination. Rectal palpation was not done, because even with sedation, the examination could not be performed safely. A nasogastric tube was placed and no gastric reflux was recovered. On abdominal ultrasonography the ventral colon wall thickness was < 9 mm. Based on the lack of response to analgesics an exploratory laparotomy was advised. The mare received 5 L of lactated Ringer’s solution before surgery.

The patient was sedated with Xylazine (MWI), 1.1 mg/kg BW, IV, and anesthesia was induced with ketamine (KetaVet; Akorn, Decatur, Illinois, USA) 2.2 mg/kg BW, IV, and diazepam (Hospira, Lake Forest, Illinois, USA), 0.1 mg/kg BW, IV. General anesthesia was maintained in dorsal recumbency with isoflurane inhalant anesthetic. The ventral abdomen was clipped and aseptically prepared and draped. An ~30 cm ventral midline incision was made using a #10 scalpel blade. Abdominal exploration revealed an edematous colon and a thickened, hyperemic cecum. A 180° large colon volvulus was found; this was reduced but neither the cecum nor the cecocolic ligament could be exteriorized.

The apex of the cecum was found entrapped within the EF from left to right. The entrapped cecum was reduced through the foramen. Reduction of the incarceration was accomplished...
by gentle traction with one hand on the left side and manipulation with the other hand on the right side of the EF. Attempts to manually dilate the foramen were not undertaken. During repositioning of the cecum rupture of a major vessel (presumably the hepatic portal vein) was noted when the abdomen began filling with blood. Blind palpation was used to detect a tear in the bleeding vessel. A significant amount of blood was lost. The mare’s systolic blood pressure dropped to 12 mmHg and her heart rate became too high to count. Given the grave prognosis, the decision was made to perform euthanasia.

On postmortem examination the peritoneal cavity was filled with approximately 20 to 30 L of partially clotted blood. The cecum was diffusely edematous, with severe mucosal hemorrhage, and contained a large quantity of blood-tinged liquid. The wall and mucosa of the colon were slightly edematous. The contents of the colon were normal in color and loose in consistency. The circumference of the EF was ~13 cm. The liver was torn in the region of entrance of the portal vein, near the EF. The edges of the right liver lobe were thin and fibrous. The segment of portal vein between the hepatic capsule and the splenic vein was torn, and a mesenteric rent in the mesoduodenum was found adjacent to the EF.

**Discussion**

To the best of our knowledge, there is only 1 previous report on entrapment of the apex of the cecum within the equine EF (1). The condition is rare, but known to occur in humans (2). Most equine reports concern small intestinal entrapment within the EF (3–5), but various parts of intestine can be entrapped within the EF (6–8). Large intestine was found entrapped in the EF in a 6-year-old crossbred gelding (6). The horse was euthanized during surgery, because reduction of the edematous and hyperemic colon through the EF was impossible due to differences in size. Another report described entrapment of the entire left dorsal colon within the EF (7). Reduction of the incarcerated intestine was possible after enterotomy of the pelvic flexure. The horse recovered uneventfully. In another report the colon could be reduced through the EF after transection of the pelvic flexure (8). In this case the necrotic part of the intestine was resected before the reduction and an end-to-end anastomosis was performed. This horse also recovered uneventfully.

We considered performing a partial typhlectomy before reducing the cecum from the EF. The prognosis for this procedure is considered good when the cecum can be exteriorized fully from the abdomen (9). The apex of the cecum was fixed within the EF, and the amputation would have to be performed within the abdomen on the right side of the EF to reach a healthy area of the cecum. We considered using 2 TA 90 staplers to carry out this amputation, to avoid contamination as much as possible (10). However, attempts to milk out the content from the entrapped part of the cecum to decrease its diameter before resection only produced a mild decrease in size of the distended apex.

The anatomy of the cecum promotes free wandering of this part of the intestine within the abdomen. The base of the cecum is attached to the ventral surface of the right kidney, to the right lobe of the pancreas, to a part of the abdominal wall, to the transverse colon, and to the root of the mesentery (11). The body of the cecum is attached to the ileum by the ileocecal fold, and to the right ventral colon by the cecocolic fold. The apex of the cecum lies medially to the right ventral colon and is not attached, which allows for free movement (11). It has been suggested that tapeworms (Anoplocephala perfoliata) can cause changes in cecal motility due to inflammation in the cecal mucosa, causing intussusceptions (9). In the present case no tapeworms were found in the cecum during postmortem examination.

Predisposing factors for EFE are behavior disorders such as crib-bitting or windsucking (12,13). On the other hand, horses that are easily frightened, sweat when excited, or go off their food in response to a stressful situation appear to be at reduced risk of EFE (12). The mare did not show any of these behavior disorders. Several studies have not found any correlation between age-related decreased liver size and risk of small intestine EFE (12–14,15) or between gender of horses and this kind of entrapment (4,5,12). The risk of EFE is increased for horses that had a colic episode within the last 12 mo and horses with considerable height (mean height: 160 cm) (12). All horses that underwent colic surgery for EFE, or those in the higher risk group, could be considered candidates for prophylactic laparoscopic closure of the EF. A method for EF closure with titanium coils has been described and is considered safe, without major postoperative complications (16). A more recent study by Van Bergen et al (17) described closure of the EF with polypropylene mesh (FEMC) and, compared to closure with the coils, this method led to a more consistent closure of the EF (17). Van Bergen et al (18) have published a follow-up study, in which spontaneous closure of the EF after an EFE colic surgery was documented in about 50% of the cases.

The mare herein had shown moderate to severe signs of abdominal pain. The severity of pain varies among horses affected by EFE. One study reported that 38% of horses with herniation of the small intestine through the EF did not show signs of abdominal pain at the referral hospital (3). Other studies report horses with signs of moderate to severe pain at admission (4,5,12).

The short-term survival rate after surgery for small intestinal EFE is ~78.5% (3,19), whereas the survival rates at 1 and 2 y after surgery were 50.6% and 34.3%, respectively (19). The major factors influencing long-term post-surgery survival are: preoperative TP level, preoperative PCV, duration of surgery, and repeated laparotomy (20). Specific postsurgical complications of EFE described in 1 report (21) were fatal hypoglycemia, a large thrombus in the portal vein, and areas of ischemic necrosis in the liver. One study focused on fatal bleeding from the portal vein. Rupture of the portal vein can occur spontaneously or as a complication of a correction (21).

The size of the EF ranges from 11.6 cm +/- 2.6 cm (22). The cecum has a larger diameter (~15 cm for the cecal body) than the window of the foramen. The circumference of the EF reported in the postmortem examination was ~13 cm. The difference in diameters confirms that the reduction of the edematous cecum from the EF was difficult to perform without causing a tear in the hepatic portal vein.
The necropsy revealed that the lethal bleeding had occurred from the hepatic portal vein. Theoretically this could have also happened from the other vasculature structure enclosed within the EF boundaries. Van Bergen et al. (15) confirmed the presence of 3 vasculature structures in the EF, which are immediately adjacent to the omental vestibule. These are the caudal vena cava, which lies dorsally and is largely embedded in the hepatic tissue; the hepatic artery, that runs for part of its course within the hepatopancreatic fold and the hepatoduodenal ligament, ventral to the omental vestibule; and the hepatic portal vein which runs parallel to the hepatic artery, close to the caudal vena cava, which lies dorsally and is largely embedded in the hepatopancreatic fold and the hepatoduodenal ligament. All 3 vasculature structures should be considered as potential sources of perioperative lethal bleeding during colic surgery.

Cecal EFE is difficult to diagnose before surgery. Clinical signs are nonspecific and consist mostly of pain not responsive to conservative treatment. This pain is often the reason for deciding to proceed with surgical treatment. Time between first colic symptoms and surgery is very important, and strongly related to short- and long-term survival. In the present case the entrapped cecum was already edematous and hemorrhagic, and this made the reduction of the cecum very difficult, which led to portal vein rupture.

Acknowledgment

The authors thank the Department of Pathology of the University of Kentucky for conducting the necropsy and providing a comprehensive report.

References


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Case Report  Rapport de cas

Outcome of prolonged acute vena cava occlusion after iatrogenic transection and repair in a dog

Marie-Chantal Halwagi, Evan Crawford, Katie Hoddinott, Michelle L. Oblak

Abstract — A 12-year-old castrated male Airedale terrier dog was diagnosed with a hepatocellular carcinoma in the right medial liver lobe. During tumor resection, inadvertent stapling and transection of the caudal vena cava occurred. Complete caval occlusion was required for 18 minutes and primary anastomosis was completed. The dog received 2 blood transfusions and developed mild pelvic limb edema after surgery. Computed tomography evaluation 9 months after surgery showed collateral circulation and suspected stricture of the vena cava with an absence of clinical effect. The dog remained alive and asymptomatic more than 1 year after surgery.


Surgery is the treatment of choice for hepatic tumors in dogs and there is a median survival of > 1460 d following complete surgical resection of a single massive hepatocellular carcinoma (1). Morbidity and mortality associated with liver lobectomy depend on which lobe is affected (2). Due to the location and close proximity to the vena cava, large right-sided tumors carry an increased risk of accidental vessel transection and hemorrhage with a 4.8% intraoperative mortality rate, due to exsanguination, in 1 study (1). This case report records a successful clinical outcome following supra-renal caudal vena cava transection, transient occlusion for more than 15 minutes and primary repair of the vessel.

Case description

A 12-year-old castrated male Airedale terrier dog, weighing 29 kg, was presented to the Ontario Veterinary College Health Sciences Centre for evaluation because of a 5-day history of inappetence. Physical examination was unremarkable and vital parameters were within normal limits. A marked elevation in alanine aminotransferase (ALT) and aspartate aminotransferase (AST) and a mild increase in alkaline phosphatase (ALP) were noted on the serum biochemistry profile (Table 1). A coagulation profile was within the normal range. Three-view thoracic radiographs showed no evidence of pulmonary metastatic disease and a large right-sided hepatic mass was noted on abdominal ultrasound with possible invasion of the caudal vena cava (CVC).

Computed tomography (CT) evaluation (Brightspeed; GE Healthcare, Milwaukee, Wisconsin, USA) of the abdomen identified an 11.6 × 10.7 × 13.7 cm mass located in the cranial right quadrant, most consistent with hepatic origin. Adjacent to the mass was marked compression of the CVC as well as moderate narrowing of the portal vein with no evidence of thrombi (Figures 1, 2). In the left lateral and medial hepatic lobes, 2 well-circumscribed intraparenchymal nodules were noted measuring 2.5 cm each. Mild abdominal effusion was present. The originating liver lobe could not be conclusively determined based on imaging but was suspected to be the right...
lateral lobe with concern for adhesions to the hepatic CVC without invasion.

The patient was placed under general anesthesia for surgery with a standard protocol and antibiotics (Cefazolin; Teva Canada, Toronto, Ontario), 22 mg/kg body weight (BW), IV, were administered every 90 min. On exploration, caudal displacement of the stomach and duodenum was visualized and a large mass was present with adhesions to the diaphragm. The additional hepatic nodules noted using computed tomography (CT) could not be visualized. A releasing incision was performed along the central tendinous portion of the diaphragm, approximately 2 cm long in the dorsal to ventral direction, to allow for caudal retraction of the mass. The mass was identified filling the right side of the cranial abdomen, and associated with the right medial liver lobe. The mass was dissected free from the diaphragm and lateral liver lobe. The gallbladder was preserved. Following dissection, the mass was more freely moveable and could be partially exteriorized from the abdomen, although cranial visualization remained challenging. The suspected vascular pedicle was identified, the stump was placed as high on the pedicle as possible, 5 mm proximal to the tumor and against the diaphragm at the hilus. The pedicle was stapled with a 30-mm vascular thoraco-abdominal stapler [TA30V; Covidien (Medtronic), Mansfield, Massachusetts, USA] and transected distal to the staple line to remove the associated mass and liver lobe. Following transection, the mass and associated liver lobe remained attached to the liver craniolaterally and there was significant hemorrhage from the transected stump distal to the staples. The origin of the hemorrhage was determined to be the caudal margin of the transected CVC with the staple line identified crossing the cranial margin. The mass remained adhered to the caudal portion of the CVC. A Satinsky clamp was immediately placed on the CVC, caudal to the mass. The mass and liver lobe were dissected away from the distal portion of the transected CVC. A second Satinsky clamp was then placed across the cranial margin of the resection site and the staples were removed from the vena cava portion of the staple line. The cranial border of the CVC was debrided minimally to avoid significant shortening and anastomosis of the 2 ends of the CVC was carried out using 5-0 polypropylene suture (Prolene; Ethicon, Somerville, New Jersey, USA). First the dorsal margins were apposed with a simple continuous suture line followed by a second continuous suture line on the ventral margin. The caudal Satinsky clamp was released and several additional small caval tears were noted associated with previous staple lines. The clamp was replaced and the defects were repaired with interrupted sutures of 5-0 polypropylene. Release of the clamps resulted in return of blood flow with an additional longitudinal defect noted on the dorsolateral wall of the vena cava. Partial occlusion with a Satinsky clamp allowed repair of the defect with 5-0 polypropylene in an interrupted pattern while permitting some resumption of caval flow. Following release of all clamps, minimal blood loss was noted through the needle puncture sites and complete blood flow was returned. An approximately 25% reduction in caval diameter was noted at the level of the main suture line. The time for total CVC occlusion was estimated at 18 min, with partial occlusion occurring for an additional 5 min. The remaining vascular pedicle of the affected lobe and associated mass was stapled with a thoraco-abdominal stapler and was transected distal to the staples. The diaphragm was closed with 3-0 polydioxanone (PDS; Ethicon) in a simple continuous pattern and transdiaphragmatic thoracocentesis was performed to achieve negative pressure. The vena cava was re-evaluated and no evidence of bleeding was present at that time. The anastomosis site was covered with an absorbable hemostatic agent (Surgicel Absorbable Hemostat; Ethicon).

Following transection and during complete occlusion of the CVC, the patient received a 200 mL whole blood transfusion.

<table>
<thead>
<tr>
<th>Period</th>
<th>PCV (%)</th>
<th>TS (g/L)</th>
<th>Lactate (mmol/L)</th>
<th>BUN (mmol/L)</th>
<th>ALT (U/L)</th>
<th>ALP (U/L)</th>
<th>AST (U/L)</th>
<th>PT (s)</th>
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<td>38</td>
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<td>193</td>
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<td>75</td>
<td>1.5</td>
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<td>50</td>
<td>4.5</td>
<td>15 to 26a</td>
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<td>28</td>
<td>52</td>
<td>1.7</td>
<td>30 to 40a</td>
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<td>48 h post-op</td>
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<td>50</td>
<td>2.1</td>
<td>30 to 40a</td>
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<td>72 h post-op</td>
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<td>56</td>
<td>1.3</td>
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<td>5 d post-op</td>
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<td>14 d post-op</td>
<td>46</td>
<td>81</td>
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Summary of relevant laboratory data during hospitalization

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Reference range</th>
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<tbody>
<tr>
<td>Urea</td>
<td>(5.5 to 10.5)</td>
</tr>
<tr>
<td>Creatinine</td>
<td>(110 to 150)</td>
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</tbody>
</table>

*Measured with the Azostix. op — operation; PCV — packed cell volume; TS — total solids; BUN — blood urea nitrogen; USG — urine specific gravity; ALP — alkaline phosphatase; ALT — alanine aminotransferase; AST — aspartate aminotransferase; PT — prothrombin time; PTT — partial thromboplastin time.
(3.6 mL/kg BW) and 4.28 mL/kg BW of hydroxyethyl starch (Voluven; Fresenius, Bad Homburg, Germany) during the surgery. The arterial blood pressures ranged from 165/85 mmHg (mean: 105 mmHg) to 45/35 mmHg (mean: 38 mmHg). Isoflurane was reduced from 2.0% to 0.5% during hypotension. The patient was maintained on continuous rate infusion (CRI) of fentanyl (Sandoz Canada, Boucherville, Quebec), 0.005 to 0.01 mg/kg BW per hour and dopamine (Baxter, Mississauga, Ontario), 0.003 to 0.01 mg/kg BW per minute throughout the surgery. No central venous access was available to monitor changes in venous pressure following the caval occlusion. Recovery from anesthesia was uneventful. Isofluorane was discontinued and the patient was extubated 10 min later. Prior to extubation, direct arterial blood pressure was 120/55 mmHg (mean: 72 mmHg) and the patient was maintained on the same fluid supplementations and infusions (fentanyl; dopamine) until recovery in the intensive care unit (ICU).

On admission to the ICU, the patient was tachycardic and anemic and intravenous crystalloids with electrolyte supplementation were administered after an additional 200 mL of whole blood, which resulted in stabilization of the heart rate and a post-transfusion PCV of 23%. Direct arterial blood pressure remained > 114/72 mmHg (mean: 81 mmHg). A urinary catheter was placed and the patient was maintained with Fentanyl, 2 to 6 μg/kg BW per hour constant rate infusion (CRI) and Ketamine (Vetalar; Bioniche Animal Health Canada, Belleville, Ontario), 0.1 to 1 mg/kg BW per hour CRI, for pain management.

During the first 12 h after surgery, occasional ventricular premature contractions (VPC) were present but no abnormalities requiring intervention were noted. Twenty-four hours after surgery the patient was treated with a CRI of magnesium sulfate (Fresenius Kabi Canada, Richmond Hill, Ontario), 5 mg/kg BW
per hour, IV due to increasing numbers of VPCs. The PCV and TS remained about the same, slightly under the low end of normal. Lactate value spiked 24 h following surgery, but quickly returned within normal range. Renal parameters were monitored with Azostix Reagant Strips (Siemens Healthcare Diagnostics, New York, New York, USA) and elevated blood urea nitrogen (BUN) was noted 36 h after surgery (Table 1). This was suspected to be pre-renal in origin, as urea and creatinine remained normal on the biochemistry profile 24 and 48 h after surgery. The rate of intravenous fluids was increased, from 3 times (150 mL/h) to 4 times the estimated maintenance requirements (200 mL/h) to address the suspected dehydration. Presumed pigmenturia was noted in the urine collection bag 36 h after surgery with a urine PCV of 3%. Throughout the remainder of hospitalization, the patient’s urine varied from red to a normal yellow color. A urine culture demonstrated an absence of bacterial growth.

An ultrasonographic evaluation (Philips iU22 ultrasound; Andover, Massachusetts, USA) was performed 24 h after surgery to visualize the anastomosis site and evaluate for evidence of thrombus. A minimal amount of free abdominal fluid was noted, with a PCV of only 3%. The affected portion of the CVC could not be imaged due to residual free gas in the abdomen but adequate blood flow was present at the level of the porta hepatis as well as within the hepatic veins; therefore, caval thrombus was thus deemed unlikely. Forty-eight hours following surgery, the patient developed moderate edema in the right pelvic limb. Frequent massage and physiotherapy was initiated. The patient was otherwise stable with unchanged blood gas and electrolyte values.

From 72 h after surgery to discharge, the patient’s clinical condition progressively improved. Intravenous medications were transitioned from CRI (Fentanyl 2 to 6 μg/kg BW per hour CRI; Ketamine 0.1 to 1 mg/kg BW per hour CRI) to intermittent administration [Hydromorphone hydrochloride (Sandoz Canada)], 0.025 to 0.05 mg/kg BW, IV q6h, and then to oral medication (Tramadol HCl; Chiron Compounding Pharmacy, Guelph, Ontario), 100 mg PO, q8h. Intravenous fluid therapy was decreased to daily maintenance requirements. The PCV progressively decreased with no overt source of hemorrhage. On day 5 following surgery, the dog became lethargic and blood gas analysis showed a drop in PCV to 17% (Table 1). A pRBC transfusion was administered, which resulted in improvement of both the anemia and attitude. No further decrease in PCV was noted over the 3 remaining days prior to discharge and the patient was discharged 8 d after surgery. At the time of discharge, the PCV had reached 30%. Mild pelvic limb edema was still present but rapidly improving. Histopathology of the resected mass was consistent with hepatocellular carcinoma (HCC).

Recheck examination 6 d after discharge as well as 2, 3, 6, and 9 mo after surgery showed a good clinical condition and a normalized alanine aminotransferase (ALT). The pelvic limb edema was completely resolved by the 2-month recheck. Repeat ultrasounds were performed at the rechecks and at 2 mo there was some restriction of visualization at the anastomosis site but no evidence of thrombus formation within the visualized segments of the CVC. At 6 mo, ultrasound showed no evidence of caval thrombus formation but a hyperechoic hepatic nodule was noted in the left medial lobe, that was previously visible on CT but not ultrasonographically. A CT-scan performed 9 mo after surgery showed no evidence of local recurrence and that the previously visualized nodule in the left medial lobe was slightly larger (3.6 × 2.7 × 4 cm) (Figure 3). A caval narrowing with secondary extensive venous collateral circulation was also identified (Figures 4A, B, C). The owner reported the patient had great energy and appetite.

**Discussion**

This case report describes a successful outcome following acute transection and repair of the CVC during right liver lobectomy resulting in complete occlusion of the CVC for more than 15 min. Following accidental transection, the options for this patient were primary repair or euthanasia. Repair was elected as the patient was stable under general anesthesia prior to transection. Good long-term outcome would be expected with adequate removal of the primary tumor as it was localized and invading one side of the liver (1,2). While there are several reports of caveotomy for obstructive neoplastic disease and experimental studies of recovery following temporary caval occlusion, to the authors’ knowledge this is the first report in a clinical case undergoing prolonged caval occlusion with complete recovery (3–5).

Liver lobectomy in dogs is a relatively straightforward procedure as the liver has a consistent vascular and biliary anatomy.
Right liver lobectomies have been associated with a higher morbidity and mortality, due to their close proximity to the CVC (1). In our patient, the mass was very large, hilar, and adherent to the surrounding structures, including the diaphragm and vena cava. In addition, our patient was very deep chested, resulting in limited cranial visualization. We suspect all of these factors contributed to the iatrogenic transection. To avoid this complication in the future, the authors recommend being cautious when attempting to exteriorize such a large mass, to avoid flattening the large vessels, in addition to visualizing the path of the vena cava prior to transection. In this patient, the diaphragm was released to allow caudal retraction of the mass but it may have been more appropriate to perform a caudal sternotomy in order to improve visualization. Due to the size of the mass and proximity to the diaphragm, stapling was the only feasible method for ligation without a sternotomy, but improved visualization may have allowed for more careful dissection and alternative ligation methods.

Experimental studies have shown that dogs are able to achieve complete hemodynamic recovery within 5 min, following acute complete caval occlusion for 8 min (7). The intraoperative hemodynamic effects of complete occlusion in our patient were similar to those reported by Hunt et al (7) and included a moderate drop in arterial blood pressure with a compensatory increase in heart rate, which improved following anastomosis and re-establishment of blood flow. In our case the hemodynamic effects were confounded by blood loss, which may have prolonged the hypotension, but ultimately there were no significant postoperative cardiovascular effects noted in our dog.

The presence of collateral circulation is one possible reason for the lack of significant long-term effects of prolonged occlusion in our patient. Previously, complete occlusion has been shown to result in the development of collateral circulation in the dog. A 1961 experimental study by Horvath et al (4) created permanent complete acute occlusion of the caudal vena cava to quantify the development of collateral circulation. In the report, the authors hypothesized that collateral circulation developed quickly and this was the reason for the lack of significant physiologic effects after observing minimal change in blood volume measured before and during acute occlusion. Chronic progressive CVC occlusion has also been documented to result in the development of collateral circulation. In one experimental study, gradual occlusion over a 2-week period, with complete occlusion at week 2, resulted in the formation and development of collateral vessels on venograms performed 3 wk after surgery (8). While unusual, the absence of visible collateral circulation in our case did not preclude its presence. In fact, 9 mo after surgery, CT scan images identified an extensive venous collateral circulation and caval narrowing. This finding may have been a new development, or could have been present but progressive with the decreased vena cava diameter secondary to the repair.

In addition to the hemodynamic effects of acute CVC occlusion during surgery, possible postoperative consequences anticipated in this patient included pelvic limb edema, post-hepatic portal hypertension, reduced cardiac output leading to myocardial ischemia, protein-rich abdominal effusion (Budd-Chiari like syndrome), renal or hepatic failure (9,10), disseminated intravascular coagulation, thromboembolic disease, and potentially death (11). The only documented side-effect in this patient was the development of pelvic limb edema after surgery. The development of edema in this patient may have been for a number of reasons including the presence of a small thrombus in the iliac vein or vascular stasis from prolonged recumbency. No specific treatment was required for resolution of the edema, aside from application of warm packs and massage to encourage lymphatic flow, and no additional swelling or thrombotic events were noted. Thromboelastography could have been helpful, in order to detect an early hypercoagulable state (12).

Venous stasis and thrombus formation due to acute occlusion and endothelial injury were potential consequences of occlusion and anastomosis of the CVC (13). Due to the potential complications associated with systemic anticoagulants, challenges with dosing and monitoring effects in veterinary patients, and concerns for potential continued hemorrhage from the CVC anastomosis site, we did not elect postoperative anticoagulants in this patient. A plan was in place to initiate this treatment if clinical evidence of a significant thrombus developed. Two ultrasound examinations were performed following the surgery to monitor for signs of venous turbulence or appearance of thrombosis. On the first ultrasound examination, evaluation of the site was limited due to the presence of a pneumoperitoneum but a thrombus was not suspected at that time, nor was one present on ultrasound 2 wk after surgery. Clinically, the patient did not demonstrate signs of caval hypertension or any evidence of major thrombotic disease. Despite lack of evidence of a thrombus and presumed patency of the vena cava at the anastomosis site, the patient went on the develop collateral circulation 9 mo after surgery which could have been an indication of partial or complete occlusion, either due to thrombosis or eventual stricture.

The patient’s PCV declined following surgery and had decreased from 23% after surgery to 17% on day 5 despite the absence of hemoabdomen or clinical hemorrhage (Table 1). The reason for this progressive decline in PCV is unclear, but likely multifactorial. We suspect that this decrease could have been due to hemolysis secondary to a transfusion reaction, especially given the development of pigmenturia around the same time. Furthermore, hemodilution due to the high rate of crystalloid administration, as well as redistribution and splenic sequestration could have participated in the drop in PCV. Other hypotheses include endothelial injury causing red blood cell damage or a consumptive hemolytic anemia due to an inflammatory process (14). Given the progressive anemia and consistent clinical signs, a second pRBC transfusion was administered at 5 d post-surgery and the PCV remained stable until discharge. At 6 and 9 mo follow-up there was no evidence of progressive or recurrent anemia.

This clinical case confirms the findings of previously published experimental studies, reporting the ability of dogs to survive prolonged acute vena cava occlusion. It also demonstrates that a good outcome and long-term survival are possible following accidental transection and re-anastomosis of the CVC. Based on our experience, acute transection and prolonged occlusion of the hepatic CVC can result in minimal postoperative
complications in a dog undergoing resection of HCC and surgical repair should therefore be considered in similar clinical situations where inadvertent CVC transection occurs, if primary repair is possible.

Acknowledgment

The authors acknowledge Dr. Cyrielle Fink for her assistance with image collection and labelling.

References

Case Report  
Rapport de cas

Intranasal mast cell tumor in the dog: A case series
Alison Khoo, Amy Lane, Ken Wyatt

Abstract — The medical records of 4 dogs with histologically confirmed intranasal mast cell tumors (MCTs) were retrospectively evaluated to determine their biological behavior. Information on signalment, presenting clinical signs, tumor grade, treatment administered, and survival times was obtained from the medical record. All 4 patients had high grade tumors and received chemotherapy. Survival times ranged from 27 to 134 days. All 4 dogs showed signs of local or distant disease progression, suggestive of an aggressive behavior of intranasal MCTs.

Résumé — Tumeur mastocytaire intranasale chez le chien : une série de cas. Les dossiers médicaux de quatre chiens qui avaient eu des tumeurs mastocytaires intranasales confirmées par histologie ont été rétrospectivement évalués afin de déterminer leur comportement biologique. Des renseignements sur le signalement, les signes cliniques de présentation, le grade de la tumeur, le traitement administré et les temps de survie ont été obtenus dans le dossier médical. Les quatre patients avaient des tumeurs de grade élevé et ont reçu de la chimiothérapie. Les temps de survie ont varié de 27 à 134 jours. Les quatre chiens ont manifesté des signes de progression locale ou distante de la maladie, suggérant un comportement agressif des tumeurs mastocytaires intranasales.

Mast cell tumors are a commonly diagnosed cutaneous tumor, accounting for 7% to 21% of all canine skin tumors (1,2). These tumors have a range of clinical presentation, varying from benign to malignant behavior. The extent of ancillary diagnostic workup and treatment is predicated on the presence or absence of negative prognostic factors such as histological grade, clinical stage, growth rate, cell proliferation rate, recurrent disease, and the presence of systemic signs (3,4). In some studies, anatomic location has been used as a predictor of the biologic behavior of MCTs in dogs, with tumors in the preputial, scrotal, subungual region, oral cavity, and other mucous membrane sites associated with a higher grade tumor and poorer prognosis (3,4). Visceral MCTs are rare but are associated with systemic signs and carry a guarded prognosis (5,6). There have been few reports discussing mucosal or mucocutaneous MCTs, with most reports focusing on oral, perineal, preputial, and subungual sites. One study investigating MCTs located on the canine muzzle showed a regional metastatic rate of 58% (7). To our knowledge, there have been no reports describing the behavior of intranasal MCTs. The purpose of the study reported here was to retrospectively analyze the biologic behavior and prognosis of dogs with intranasal MCTs. The clinical, diagnostic, and histologic findings associated with a series of 4 dogs diagnosed with intranasal MCTs are described.

Case descriptions

Case 1
A 14-year-old neutered male crossbreed dog (Table 1) was presented to the referring veterinarian for vomiting of unknown cause. Three days prior to presentation the dog was anorexic, polydipsic, and lethargic. Previous clinical signs included noisy inspiratory stertor with nasal discharge. Physical examination by the referring veterinarian revealed persistently enlarged left mandibular lymph nodes. All other findings were unremarkable. An abdominal ultrasound examination revealed no abnormalities. The patient was treated conservatively with an oral electrolyte solution, dietary modification, and metoclopramide (Metomide; Delvet Pty, Asquith, NSW, Australia), 0.2 mg/kg body weight (BW), IV, q12h, with no improvement, and was subsequently referred to an internal medicine specialist.

Physical examination at the referral hospital revealed persistently enlarged left mandibular lymph nodes. All other findings were unremarkable. An abdominal ultrasound examination revealed no abnormalities. The patient was again managed conservatively for 2 wk using dietary modification and anti-emetics, but there was no clinical improvement.

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Upper gastrointestinal endoscopy revealed fresh ulceration of the mucosa of the esophagus, pyloric antrum, and duodenum. The mucosa of the duodenum also had a cobblestone appearance and certain sections appeared to be edematous. The patient was examined for possible causes of gastric ulceration. A subcutaneous mass on the neck was aspirated and confirmed to be a lipoma. The mandibular lymph nodes were aspirated again and showed large numbers of eosinophils. The patient’s owner confirmed that the dog had not received any ulcerogenic drugs or seen to consume any erosive substances. Histopathology results from the stomach and duodenal biopsies showed a mild gastritis and enteritis with no sign of neoplasia. The patient was examined for possible causes of gastric ulceration. A subcutaneous mass on the neck was aspirated and showed poorly differentiated mast cells. The mandibular lymph nodes were suggestive, but not definitive, of a metastatic MCT with necrosis. Nasal biopsies demonstrated a granulomatous reaction with an eosinophilic component but no convincing evidence of neoplasia. The dog was treated for eosinophilic rhinitis using prednisolone (Prednisone; Apex Laboratories, Somersby NSW, Australia), 0.6 mg/kg BW, PO, q24h, and gastroprotectants.

Two weeks later the patient developed recurrent swelling of the neck and jaw. The left mandibular lymph node was still enlarged and the patient had developed mild dyspnea. Repeat nasal biopsies and wedge biopsies of the mandibular lymph node confirmed the presence of a high grade MCT in both sites based on Patnaik grading criteria. Treatment was initiated following a vinblastine (DBL Vinblastine; Aspen Australia, St Leonards NSW, Australia), lomustine (Ceenu; Bristol-Myers Squibb, Noble Park, North Vic, Australia), and prednisolone (Apex Laboratories) chemotherapy protocol (8). Famotidine (Pfizer, Belmont WA, Australia), 0.6 mg/kg BW, PO, q24h, and omeprazole (Gastroshield; Merial Australia Pty, North Ryde, NSW, Australia), 0.6 mg/kg BW, PO, q24h, were also prescribed. After the first cycle of the chemotherapeutic protocol, the patient was switched to single agent lomustine (Bristol-Myers Squibb) for the remaining 3 treatments due to a better initial clinical response to this drug. During this time the patient showed variable responses to treatment with intermittent nasal discharge and dyspnea, a decrease in overall swelling of the mandibular area, and occasional vomiting. Worsening clinical signs were seen when attempts were made to reduce the dose of prednisolone. The patient developed neurological signs including head pressing, pacing, and ataxia, suggestive of brain involvement, and was euthanized 4 mo after diagnosis.

Case 2
A 15-year-old neutered male Maltese cross dog (Table 1) was presented to the referring veterinarian for sneezing and gagging and was treated with doxycycline (Doxycycline; Apex Laboratories) and chlorpheniramine (Iramine; Mavlab Pty, Slacks Creek, QSLD, Australia) with no clinical improvement. Skull radiographs showed a soft tissue opacity in the caudal left nasal cavity. A nasal flush was conducted and 50% of the cells were mast cells. Bacterial and fungal culture was negative. The patient was subsequently referred to an oncologist for further investigation.

Rhinoscopic examination showed increased mucus in the left nasal cavity and a normal right nasal cavity. In-house impression smears from the left cavity mucosa showed an almost pure population of mast cells. While awaiting histopathology results from nasal biopsies, the patient was treated with a single dose of dexamethasone (Dexafort; Intervet/Schering-Plough Animal Health, Bendigo East Vic, Australia), 0.1 mg/kg BW, IV, and chlorpheniramine (Iramine; Mavlab), 0.5 mg/kg BW, IM.

The histopathologic diagnosis was an undifferentiated round cell tumor, most likely a MCT. The patient commenced a vinblastine, lomustine, and prednisolone chemotherapy protocol (8). Half way through the second cycle, the patient developed multiple masses in the liver, ascites, and a neck mass which was aspirated and showed poorly differentiated mast cells. The patient was subsequently euthanized 40 d after diagnosis.

### Table 1. Case summaries

<table>
<thead>
<tr>
<th>Case number</th>
<th>Signalment</th>
<th>Presenting clinical signs</th>
<th>Stage</th>
<th>Substage</th>
<th>Histological grade</th>
<th>Overall survival times (days)</th>
<th>Concurrent illnesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14-year-old MN crossbreed dog</td>
<td>Vomiting and inspiratory stertor</td>
<td>T1 N1 M0</td>
<td>b</td>
<td>Grade 3</td>
<td>65</td>
<td>Nil</td>
</tr>
<tr>
<td>2</td>
<td>15-year-old MN Maltese cross</td>
<td>Sneezing</td>
<td>T1 N1 M0</td>
<td>a</td>
<td>Undifferentiated round cell tumor</td>
<td>40</td>
<td>Nil</td>
</tr>
<tr>
<td>3</td>
<td>12-year-old FS Kelpie cross</td>
<td>Stertorous breathing</td>
<td>T1 N1 M0</td>
<td>a</td>
<td>High grade well-differentiated</td>
<td>27</td>
<td>Grade 3/6 mitral valve murmur</td>
</tr>
<tr>
<td>4</td>
<td>13-year-old FS Shetland sheepdog</td>
<td>Sneezing, reverse sneezing, open mouth breathing</td>
<td>T1 N0 M0</td>
<td>b</td>
<td>Grade 3</td>
<td>134</td>
<td>Nil</td>
</tr>
<tr>
<td>5</td>
<td>5-year-old ME Kerry blue terrier</td>
<td>Depigmentation of left nares</td>
<td>T1 N1 M0</td>
<td>a</td>
<td>Grade 3</td>
<td>661</td>
<td>Nil</td>
</tr>
</tbody>
</table>

MN — male neutered; FS — female spayed.
Case 3
A 12-year-old neutered female Kelpie cross dog (Table 1) was presented to the referring veterinarian with a history of progressive stertorous breathing and snoring while asleep. The dog was treated with cephalixin (Cephalexin; Apex Laboratories) and antihistamines and showed slight improvement, but clinical signs recurred when the medication was discontinued. A computed tomography (CT) scan of the head revealed a nasopharyngeal mass extending into the nasal cavity and markedly enlarged, contrast-enhancing retropharyngeal lymph nodes. The dog was subsequently referred to an oncologist. Physical examination at the referral hospital revealed enlarged left mandibular and left prescapular lymph nodes. Fine-needle aspirate cytology of the mass revealed a round cell population with large numbers of cytoplasmic granules. The histopathologic diagnosis from nasal tissue biopsies was a high grade MCT. The patient was treated with imatinib (Glivec; Novartis Australia, North Ryde, NSW, Australia) for a month before being euthanized due to local progression of the disease.

Case 4
A 13-year-old neutered female Shetland sheepdog (Table 1) was presented to the referring veterinarian with a history of increased sneezing, reverse sneezing, throat clearing, and open-mouthed breathing. Rhinoscopic examination revealed a hemorrhagic mass in the right nasal cavity and histopathologic examination of nasal tissue biopsies resulted in a diagnosis of a high grade MCT. The patient was prescribed doxycycline and prednisolone and was subsequently referred to an oncologist for chemotherapy. The patient commenced a prednisolone, vinblastine, and lomustine chemotherapy protocol (8). Clinical examination at the final treatment reported minimal airflow through the right nostril with dried blood visible at the right nares, suggestive of tumor recurrence. Four days later the patient developed seizures which were suspected to be secondary to tumor involvement of the brain. The patient was euthanized 134 d after diagnosis.

Discussion
Primary tumors of the sinonasal cavity account for 1% to 2% of all neoplasms in dogs (9). Of these neoplasms, about 80% have histologic characteristics of malignancy with adenocarcinomas being the most common, followed by squamous cell carcinomas, chondrosarcomas, and undifferentiated (anaplastic) carcinomas (10). Less frequently diagnosed sinonasal malignancies include hemangiosarcoma (11), transmissible venereal tumor, melanoma, leiomyosarcoma, neuroendocrine carcinomas, and round cell tumors (9,12). Little information exists on the biological behavior, prognostic factors, and recommended treatment for these less commonly occurring sinonasal neoplasms.

The average age of dogs diagnosed with sinonasal tumors is 10 y with medium to large breed male dogs more commonly affected (9). It is speculated that dolicocephalic breeds may be at a higher risk for developing sinonasal cancer (13,14). This is not a finding in the present study, with only 1 of 4 patients being dolicocephalic. Two of the 4 patients in this case series were male and all 4 patients were 12 y or older at presentation. None of the breeds in this study are reported to be predisposed to developing cutaneous MCTs (15).

Clinical signs in our patients overlapped with those seen in other intranasal diseases. These included intermittent and progressive unilateral epistaxis, mucopurulent nasal discharge, sneezing, difficulty breathing, and ocular discharge (9,11,16). One patient in our series also presented for vomiting, which was subsequently diagnosed as secondary to gastric ulceration. This was suspected to be a paraneoplastic syndrome secondary to the MCT, due to increased circulating histamine levels and stimulation of the gastric H2 receptors.

Mast cell tumors involving mucocutaneous areas have been described as having a grave prognosis (3,7,17). Results of the present study suggest that dogs with intranasal MCTs frequently have aggressive disease with 3 of the 4 cases diagnosed on histopathology with a high grade MCT and the remaining case being described as anaplastic with a high mitotic index. Despite the variation and lack of consensus among pathologists regarding MCT grading criteria, the present study demonstrates that 3 of 4 affected dogs were diagnosed with a high grade MCT, with short overall survival times ranging from 27 to 134 d. A previous study of grade 3 mucocutaneous MCTs showed a relatively short median survival time (MST) of 8 mo (17). In contrast, another study showed that patients with oral MCTs had a much longer MST of 52 mo (3). The decreased survival time seen with intranasal MCTs compared with other mucocutaneous MCTs could be associated with complicating factors such as brain or optic involvement, advanced stage of disease at presentation due to late onset of clinical signs, and complex regional anatomy preventing surgical treatment. Although the grading system for MCTs applies only to cutaneous masses, the use of these criteria may be clinically relevant for patients with nasal MCTs.

A limitation of the present study was the lack of CD117 immunohistochemical analysis of the biopsy samples. CD117 is a receptor tyrosine kinase protein involved in mast cell growth and differentiation. A C-kit staining pattern has been used for its predictive role of histological grade, tumor necrosis, and the biologic behavior in MCTs (18,19). Further studies on CD117 immunohistochemical analysis are needed to evaluate its prognostic value in predicting the biological behavior of mucocutaneous MCTs. AgNOR and Ki67 count as well as polymerase chain reaction (PCR) for C-kit mutation may also be beneficial.

Regional lymph node involvement was detected in 2 of 4 dogs in our series. In the remaining 2 patients, despite palpably normal lymph nodes, lymph node involvement cannot be excluded due to lack of further lymph node evaluation. Due to the retrospective nature of the study, staging tests were not uniformly performed. On presentation, none of the patients in this study showed signs of distant metastasis, which is a consistent feature of sinonasal neoplasms in general (9,16,20). However, all 4 dogs in the present study were euthanized due to progression of disease beyond the nasal cavity suggesting that complete staging at presentation, including a computed tomography (CT) scan and local lymph node aspiration, is warranted.

Treatment received by each patient in this series was largely dependent on clinician choice, the stage of disease at the time of diagnosis, and the owner’s decisions and financial constraints.
Three of the 4 patients received a similar chemotherapeutic protocol involving alternating vinblastine and lomustine treatments, with concurrent prednisolone administration. Three of 4 patients included in the present study experienced survival times of less than 19 wk. This may be due to the selection of patients with MCT of cutaneous origin in the previous study having a less aggressive behavior (15).

Radiation therapy for the treatment of intranasal carcinomas and sarcomas has demonstrated efficacy in improving patient survival times (16). One study suggested that survival times can be further improved if patients were treated surgically after radiation, although these patients developed delayed complications including chronic rhinitis, osteomyelitis, and osteonecrosis (21). To the authors’ knowledge, there have been no studies to confirm the efficacy of radiation therapy in treating intranasal round cell tumors. Radiation therapy may be useful as adjuvant or definitive therapy for unresectable intranasal MCT disease, and the lack of treatment with radiation could account for the shorter survival times of dogs in this study (22–28).

Despite the retrospective nature and small sample size of the present study, this study was able to better characterize the biological behavior of intranasal MCTs and confirm that tumor location is an important prognostic indicator of canine MCTs. Based on the results of this report, affected patients experienced a relatively short survival time with a potential for local disease progression compared with MCTs at other sites.

Acknowledgments

The authors acknowledge the assistance of Dr. Peter Bennett and associated veterinary pathologists Dr. Rodney Straw and Dr. Jerome Gagnon.

References

Case Report  Rapport de cas

Spontaneous resorption of a herniated cervical disc in a dog detected by magnetic resonance imaging

Francesca Raimondi, Beatriz Moreno-Aguado, Phil Witte, Nadia Shihab

Abstract – This report describes, for the first time in small animal literature, the spontaneous resorption of herniated Hansen type I intervertebral disc material in the cervical spine of a chondrodystrophic dog over a 4-month period, documented by magnetic resonance imaging. Clinical signs (cervical hyperpathia) responded to conservative treatment during the same period.

Résumé – Résorption spontanée d’une hernie discale chez un chien détectée par imagerie par résonance magnétique. Cet article décrit, pour la première fois dans la littérature des petits animaux, la résorption spontanée d’une hernie Hansen de type I du matériel du disque intervertébral dans la colonne cervicale d’un chien chondrodystrophique pendant une période de 4 mois et documentée par imagerie par résonance magnétique (IRM). Les signes cliniques (hyperpathie cervicale) ont répondu à un traitement conservateur durant la même période.

Cervical disc herniation is reported in 15% of dogs that suffer from intervertebral disc (IVD) herniation (1–3). A total of 15% to 61% of dogs that suffer from IVD herniation in the cervical spine present with signs of cervical hyperpathia (3,4), guarding of the neck and muscle fasciculations without neurological deficits (1,2). The lower rate of neurological deficits compared to patients with thoracolumbar IVD herniation is thought to be related to the high vertebral canal/spinal cord ratio of the cervical vertebral column (1–4).

Treatments for IVD extrusion in dogs include conservative management (strict avoidance of activity and the administration of anti-inflammatory and/or other analgesic medications) (1,2,4–6) and surgical decompression (1,2,4,5). The choice between conservative and surgical management depends on the severity of neurological dysfunction, the degree of neuronal tissue compression apparent on imaging, and financial considerations (1–7). Most neurologists agree that an initial period of conservative management is appropriate for patients that present with cervical hyperpathia (1,2,4,6).

Spontaneous resorption of degenerate nuclear material within the vertebral canal has not been documented by advanced diagnostic imaging [Computed Tomography (CT)/Magnetic Resonance Imaging (MRI)] in previous reports. The current report describes the MRI-documented spontaneous disappearance of an acute cervical intervertebral disc herniation in 1 patient which was treated conservatively. Relevant cases reported in the human literature are reviewed and the biochemical and biological factors that may be involved in the resorption of herniated cervical intervertebral disc material are discussed.

Case description

A 4-year-old, 14-kg, spayed female, cocker spaniel dog was referred to a clinic with a history of cervical hyperpathia and exercise intolerance of acute onset approximately 4 mo previously. At first examination the local veterinary surgeon had recorded a low head carriage, stiffness affecting all 4 limbs, guarding of the neck, and occasional diffuse muscular tremors affecting the neck and both forelimbs. Management had been conservative, involving cage rest and anti-inflammatory medication [gabapentin (Gabapentin Zentiva; Zentiva, Guildford, Surrey, UK)], 10 mg/kg body weight (BW), PO, q12h for the initial 2 wk.

According to the dog’s owner, the signs of neck pain had responded well during this period. However, following discontinuation of the medication the dog had shown a recurrence of signs of neck pain, again without any evidence of motor or sensory deficits.

Because of difficulties accessing a referral center a second opinion was delayed and magnetic resonance imaging (MRI) was carried out at the local veterinary practice using a mobile 1.5-Tesla MRI scanner (Philips, Guildford, Surrey, UK). The study included T2-weighted (T2W) and T1-weighted (T1W) sagittal and transverse sequences. The resulting MRI images showed a moderate quantity of well-defined T2W hypointense, T1W hypointense extradural material, located dorsal to the C3-C4 IVD space that extended cranially and caudally over a
As 4 mo had passed since the first MRI study at the local veterinary practice, a follow-up MRI investigation was recommended. The MRI was carried out using a 1.5 Tesla MRI scanner (Petvet Hallmarq, Surrey, UK). The following sequences were acquired: sagittal T2W Half-Fourier Acquisition Single-Shot Turbo Spin-Echo (HASTE) (TR 9000, TE 192, slice thickness 2.5 mm), T2W images in the sagittal (TR 2500, TE 110, slice thickness 2.5 mm) and transverse (TR 2522, TE 110, slice thickness 3.5 mm) planes and T1W images in the sagittal (TR 300, TE 17, slice thickness 2.5 mm) and transverse (TR 300, TE 17 slice thickness 3.5 mm) planes. The MRI images revealed complete resolution of the previously described IVD herniation. The changes described in the C3-C4 IVD and this IVD space remained present (Figures 1C, D).

Given the MRI study findings and the dog’s clinical improvement, medical treatment was gradually discontinued over the course of 2 wk. At telephone follow-ups 3 mo and 2 y following the second MRI investigation the clients reported no recurrence of clinical signs of cervical hyperpathia.

Discussion

Limited information is available on the clinical success of conservative treatment for suspected or confirmed IVD herniation in dogs (1,2,6) with recurrence rates reported at 33% to 36%. This report provides the first description of spontaneous resorption of Hansen type I disc extrusion in small animals at the level of the cervical spine that has been documented using MRI.

Only 1 previous veterinary case on small animals reported resolution of a Hansen type I intervertebral disc extrusion at the level of the lumbar spine detected using MRI (8). In contrast, the human literature has several reports and case series of spontaneous regression of herniated lumbar and cervical IVDs (9–19). The difficulty in justifying follow-up advanced imaging in patients which have returned to a healthy clinical status may be a contributing factor to this disparity. The ability to perform advanced imaging in humans without the associated risks of anesthesia, makes it feasible to perform safe standardized follow-up protocols documenting the extent of any disc reabsorption, while in dogs the follow-up is often limited to a clinical examination only.

The previous veterinary case documented a 3-year-old French bulldog that was presented with hyperpathia, neurological deficits, and spastic paraparesis associated with MRI findings consistent with IVD extrusion at the level of the L3-L4 intervertebral disc space (8). According to the report there was a dramatic improvement in the clinical signs (mild residual hind limbs ataxia) over approximately 5 wk and a significant reduction of the extruded intervertebral disc material was documented at a recheck MRI study. Similarities were detected with the case described in our study: both dogs affected were young adults (3- to 4-years-old) and belonging to a chondrodystrophic type breed of dogs.

In the human literature, although the spontaneous regression of herniated IVD material at the level of the lumbar spine documented by imaging has been well-established (9–14), this outcome has less frequently been reported for herniated discs at the level of the cervical spine (15–19).
The mechanism by which herniated IVD material undergoes spontaneous regression remains incompletely understood, although multiple factors related to the resorption process have been identified and described in humans (9–24) and small animals (5,25). The first (inflammatory) phase is triggered by the traumatic rupture of the dorsal annulus fibrosus causing contusion and compression of the spinal cord, local vasoconstriction followed by vasodilation and inflammation. A second phase is characterized by new blood vessel formation extending into the cellular matrix of the herniated intervertebral disc material; and by development of a strong inflammatory process, including invasion neutrophils followed by macrophages. These phagocytic cells are considered essential for removal of cellular debris and extruded IVD material (17–21).

In humans the type of disc herniation can also affect the resorption process, with spontaneous regression observed more frequently for extruded discs (Hansen type I) than for protruded discs (Hansen type II) (14–17,19). It has been suggested that this may relate to the vascularity of the tissues involved. Only the outer layer of the annulus fibrosus and the dorsal longitudinal ligament are believed to be directly supplied by blood vessels, whereas the nucleus pulposus and most of the annulus fibrosus receive nutrition by diffusion from the cartilaginous end plates (1,5,26). Extruded disk material that extends through the ruptured dorsal longitudinal ligament is therefore resorbed more effectively than protruded disc material that is confined between the layers of the annulus fibrosus, where there is a profound lack of vascularity.

These findings are consistent with reports in the small animal literature that have described repeated MRI examinations following the conservative treatment of dogs with Hansen type II IVD — associated cervical spondylomyelopathy that indicated that the protruding disc material does not decrease in size (27–28). In contrast, the Hansen type I disc extrusion previously reported in the lumbar region (8) and the one detailed in this case report spontaneously resorbed.

Studies in humans have suggested a correlation between the size of a cervical disc herniation and the likelihood of spontaneous resorption, with larger volume herniated discs being observed to regress more rapidly than smaller ones. This finding has been consistently reported by various authors and the common conclusion was that larger volumes of extruded disc material and sequestered-type disc herniations were more likely to regress. This was postulated to be associated with the severity of the inflammatory reactions, and, as such, the strength of the neovascularization and phagocytic response induced at the level of the epidural space (9–15,17–21).

In evaluations of neovascularization, enhancement with the MRI contrast agent gadolinium-diethylenetriamine penta-acetic acid (Gd-DTPA) (Magnevist; Bayer Schering Pharma, Leverkusen, Germany) has been reported to be a good indicator for predicting the probability that a herniated disc will spontaneously regress. The extension and thickness of rim enhancement in MRI is reported to be greater in extruded and sequestrated discs that are spontaneously resorbed over time (20). Unfortunately, in the present report the contrast medium was not administered to the patient during the initial MRI study; therefore, the information that could have been obtained using this medium is missing.

This report demonstrates the spontaneous regression of herniated cervical disc material in a chondrodystrophic dog and the associated resolution of clinical signs of cervical hyperpathia.

Acknowledgment

The authors thank the team at New Era Veterinary Hospital (Jersey) for their collaboration in the management of the reported case and for providing consent for our use of the initial MRI images obtained at their practice.

References


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**Book Review**

**Compte rendu de livre**

**Canine & Feline Endocrinology, 4th edition**


This book presents information pertaining to the endocrine pancreas, pituitary, thyroid, adrenal, and parathyroid glands together with their respective disorders for both canine and feline subjects. The material is packaged in a logical and predictable format with each chapter beginning with a detailed anatomical and physiological review of each endocrine system. The material then advances into the etiological and clinical presentation of endocrine derangements in the veterinary patient. One of the most valuable elements of each chapter is the detail regarding the selection, performance, and interpretation of diagnostic testing for species-specific conditions. The reader is not only provided with a comprehensive outline of the clinical presentation of illness but is guided on how to practically apply this information for the benefit of their patients. The authors’ use of concise summary tables, flowcharts, and clinical imagery are invaluable in preventing the reader from becoming overwhelmed while consulting the text in a clinical setting.

Available treatment options for the veterinary patient along with prognosis and success rates for each condition are similarly contained within each section. A strength of this book is how it enables the reader to readily access species-specific information without having to sift through extraneous details that may not be immediately applicable or of interest. It is important to note that anyone interested in details surrounding the topic of reproductive endocrinology will have to seek an alternate reference.

This text would be of significant value to veterinary students as it successfully consolidates the anatomy, physiology, and clinical aspects of canine and feline endocrinology. For practicing veterinarians, the volume provides a thorough summary of clinicopathological findings of endocrine conditions together with valuable information regarding diagnostic testing procedures and management options for their patients. It would be advised that anyone adding this text to their professional library take the time to familiarize themselves with the layout of the chapters in order to maximize their value. Ultimately this book would serve an individual well as an essential clinical reference or as a source for more in-depth study of the endocrine system.

Reviewed by Greg Parks, DVM, MPH, Currents Veterinary Centre, Edmonton, Alberta.
The eradication of bovine tuberculosis in Canada

Hugh G. Whitney

In an unmarked grave, in a forgotten corner of St. Mary’s Anglican Cemetery in Portage la Prairie, Manitoba, lie the mortal remains of 6-month-old Geoffrey Gunion Rutherford; “laid to rest under the cool sod of the prairie” (1). Geoffrey, born in early 1888, was fed milk from the family’s Jersey cow, once weaned from his mother’s milk at 3 wk of age. A short time later, a “peculiar, obstinate and intractable diarrhoea set up in the body of the child” (1) and he died on October 13, 1888 (2). Tuberculosis was a common cause of infant death at the time but was thought to be an inherited condition. Geoffrey’s family excluded this possibility as “his ancestors, male and female, had all been people of robust and vigorous constitutions” (1). The German microbiologist, Robert Koch, had isolated the cause of human tuberculosis and published his findings in 1882; however, as late as 1901 he publicly stated that only rarely was bovine tuberculosis the cause of the human disease (3). Geoffrey’s father, veterinarian John Gunion Rutherford, disagreed with Koch. Dr. Rutherford graduated from the Ontario Veterinary College in 1879 and was practicing in Portage la Prairie at the time. In 1887 he married Edith Boultbee with whom he had 4 children, Geoffrey being their firstborn and only son. Suspicion fell on the family cow, which was slaughtered and its udder described as a “mass of tuberculous disease” (1).

Dr. Rutherford was active in many aspects of the agricultural industry including clinical veterinary practice and animal breeding; however, the growing field of disease control became his passion, with tuberculosis being primary amongst the recognized infectious diseases of the day. Since cattle provided milk and meat for human consumption, both products were now identified threats. As the national and international community struggled with the science, economics, and politics of tuberculosis, Rutherford put himself into this arena, both through federal politics (MP from 1897 to 1900), administrative leadership (Canada’s first Veterinary Director-General, 1904), as well as in the scientific community (President of the American Veterinary Medical Association from 1908 to 1909).

Eventually, control was required in 3 fields: within the cattle population, within the milk supply, and within the meat industry. As the first had little technical history to guide it, advances were more rapid in the latter two. In 1905, the US novelist Upton Sinclair published The Jungle, a serialized story of immigrant labor in Chicago meat packing plants (4). Intended to be an exposé on working conditions in this industry, its unintended result was to reveal the poor hygiene and food safety standards such that meat from tuberculous animals ended up in the human food system. The reaction in the US was a follow-up investigation of these packing plants and the eventual establishment of its Meat Inspection Act, Pure Food and Drug Act of 1906 and its Food and Drug Administration (FDA). Similarly, in Canada, the book’s publication resulted in a review of the meat packing industry (a follow-up to one commissioned by Rutherford in 1904) and though the conditions weren’t as bad as those revealed in the US, they did help the passage of a federal Meat and Canned Food Act in 1907, requiring ante- and post-mortem inspection. Pasteurization of milk was commonly regulated at the municipal level, though later supported by the federal government, so was not within the purview of federal regulation. However, in 1910 Rutherford bluntly stated that “any community that permits the sale of such milk is an accessory to the crime” (3). In 1911, Rutherford, in his capacity as Chairman of the International Commission on the Control...
of Bovine Tuberculosis, stated that “Milk is the staple food of infants and young children and is usually taken in the raw state. If this milk is from a tuberculous cow, it may contain millions of living tubercle germs. Young children fed on such milk often contract the disease, and it is a frequent cause of death among them” (5).

At that moment, and from that lofty position, was Dr. Rutherford, politician and scientist, thinking about the growth in scientific evidence, the economic and trade impacts on the cattle industry, the need for greater public health intervention; or was he simply reflecting that, as a father, 23 years earlier, in an unmarked grave, in a forgotten corner of St. Mary’s Anglican Cemetery in Portage la Prairie, Manitoba, were laid the mortal remains of 6-month-old Geoffrey Gunion Rutherford. If it hadn’t been Dr. Rutherford who championed tuberculosis eradication, it would have been someone else, but it wasn’t, and this was how it started.

Dr. Rutherford was a veterinarian, Member of the Manitoba Legislative Assembly (1892 to 1896), federal Member of Parliament (1897 to 1900), President of the American Veterinary Medical Association (1908 to 1909), Veterinary Director of Canada (1904 to 1912), Livestock Commissioner of Canada (1906 to 1912), and Companion of the Order of St. Michael and St. George (1910). Surely he is someone worthy of a complete biographical effort.

References

Blackwell’s Five Minute Veterinary Consult: Avian


Blackwell’s “Five Minute” series needs no introduction, and this “Avian” text needs none either. It is a stand-alone text yet follows the usual “Five Minute” format, alphabetically covering 123 diseases and syndromes. It is useful that topics can be found in various places in the table of contents based on assorted common terminology, although it would have been helpful to also list clinical signs cross-linked to diseases and conditions. One cannot always label the disease at initial presentation. A large group of veterinary contributors, all well entrenched in the avian/exotic veterinary specialty, have worked together to provide quick access to essential clinical information and practical treatment advice. Seven appendices and algorithms provide guidance in addition to handouts and pictures of common clinical procedures found on the companion website. The appendices are easy to use, and are a helpful mix, including a formulary, hematology and biochemistry reference ranges, lab testing available, and potential zoonoses. The “Five Minute” template is carried into this avian text, allowing one to hone into the area of pressing concern, such as diagnostic guidance, medications, or background pathophysiology. If one has enjoyed the “Canine and Feline” Five Minute text, this “Avian” edition will definitely be welcome. This is a useful resource with scope and depth adequate for both vets seasoned in avian veterinary care and for those who see birds flying into the clinic as a rare event.

Veterinary Wellness  Bien-être vétérinaire

Dimensions of wellness: Change your habits, change your life
Debbie L. Stoewen

People often think about wellness in terms of physical health — nutrition, exercise, weight management, etc., but it is so much more. Wellness is a holistic integration of physical, mental, and spiritual well-being, fueling the body, engaging the mind, and nurturing the spirit (1). Although it always includes striving for health, it’s more about living life fully (1), and is “a lifestyle and a personalized approach to living life in a way that... allows you to become the best kind of person that your potentials, circumstances, and fate will allow” (2).

Wellness necessitates good self-stewardship, for ourselves and for those we care about and who care about us. For those in the helping professions, such as ourselves in veterinary medicine, wellness is a professional as well as personal responsibility. In order to ensure high-quality patient and client services, we have an ethical obligation to attend to our own health and well-being (3). Sufficient self-care prevents us from harming those we serve, and according to Green Cross Standards of Self Care Guidelines, no situation or person can justify neglecting it (3).

Wellness encompasses 8 mutually interdependent dimensions: physical, intellectual, emotional, social, spiritual, vocational, financial, and environmental (Table 1) (1). Attention must be given to all the dimensions, as neglect of any one over time will adversely affect the others, and ultimately one’s health, well-being, and quality of life. They do not, however, have to be equally balanced (1). We should aim, instead, to strive for a “personal harmony” that feels most authentic to us (1). We naturally have our own priorities, approaches, and aspirations, including our own views of what it means to live life fully.

Making the right choices for health and well-being can be challenging. Although we know what is good for us and how we can do — and be — better, we may not act on it, or if we do, we may, in due course, slide back to familiar ways. Human behavior — what we do, how we do it, and whether we will succeed — is influenced by many factors, 2 of which are of particular relevance when it comes to wellness: self-regulation and habits.

**Self-regulation**

Self-regulation is central to effective human functioning (4). It is “our ability to direct our behavior and control our impulses so that we meet certain standards, achieve certain goals, or reach certain ideals” (5). It allows us to act in our short- and long-term best interests, consistent with our deepest values (6). There’s just one limitation: self-regulation requires mental energy, and the brain is always looking for ways to conserve energy (i.e., save effort) (7,8).

**Habits**

Habits, in contrast, require very little energy (7,8). As Duhigg, author of The Power of Habit: Why We Do What We Do in Life and Business says, “Any behavior that can be reduced to a routine is one less behavior that we must spend time and energy consciously thinking about and deciding upon” (7). With the cognitive economy and performance efficiency of habits (9), the brain can conserve self-regulatory strength to focus on the important decisions in life (9), and free us to engage in thoughtful activities, such as reflecting on the past and planning for the future.

Habits are powerful. With about 40% of our everyday behavior repeated in the form of habits, they shape our very existence, and ultimately, our future (8). Habits, in fact, are key to wellness. For better or worse, habits very much influence health, well-being, and quality of life. If you are striving to improve these, you need to think about habits, because if you change your habits for the better, you change your life for the better (8).

Technically, a habit is “a behavior that is recurrent, is cued by a specific context, often happens without much awareness or conscious intent, and is acquired through frequent repetition” (8). It can be regarded as a formula (or “habit loop”) that the brain automatically follows: “When I see cue, I will do routine in order to get a reward” (7). Studies indicate that once formed, habits become encoded in brain structures and can never truly be eradicated — only replaced with stronger habits (7). That’s why they are so difficult to change. It’s not just a matter of willpower (i.e., self-regulation); it’s a matter of rewiring the brain. To change a habit, you need to create new routines: Keep the old cue, and deliver the old reward, but insert a new routine (7).

Inserting new routines is not easy. Despite knowing what’s good for us and best intentions, habits tend to keep us doing what we always do (10). They are difficult to change — any of us can attest to this. But we can maximize the probabilities for success with 2 essentials: self-awareness and strategies. Both are indispensable to successful habit formation (8).

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Self-awareness

Change becomes much more achievable if you pay attention to who you are and insert routines that take advantage of your strengths, tendencies, and aptitudes. With self-awareness, you can cultivate the habits that work for you. Consider, for instance, differences in circadian rhythms. Circadian rhythms reflect our natural tendencies for sleeping and waking and influence our energy and productivity at different times in the day (11). The odds of success to improve your fitness won’t increase if, for example, you decide to rise an hour earlier to exercise each day when you happen to be a “night owl” rather than “morning lark.” Self-awareness includes knowledge about other aspects of self as well, such as whether you are a marathoner, sprinter, or procrastinator; under- or over-buyer; simplicity or abundance lover; finisher or opener; and familiarity or novelty lover (8). It also includes whether you are promotion- or prevention-focused, and whether you like taking small or big steps (8).

Table 1. Dimensions of wellness

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Description</th>
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<tbody>
<tr>
<td>Physical Dimension</td>
<td>• Caring for your body to stay healthy now and in the future</td>
</tr>
<tr>
<td>Intellectual Dimension</td>
<td>• Growing intellectually, maintaining curiosity about all there is to learn, valuing lifelong learning, and responding positively to intellectual challenges</td>
</tr>
<tr>
<td>Emotional Dimension</td>
<td>• Understanding and respecting your feelings, values, and attitudes</td>
</tr>
<tr>
<td>Social Dimension</td>
<td>• Maintaining healthy relationships, enjoying being with others, developing friendships and intimate relations, caring about others, and letting others care about you</td>
</tr>
<tr>
<td>Spiritual Dimension</td>
<td>• Understanding how your social, natural, and built environments affect your health and well-being</td>
</tr>
<tr>
<td>Vocational Dimension</td>
<td>• Preparing for and participating in work that provides personal satisfaction and life enrichment that is consistent with your values, goals, and lifestyle</td>
</tr>
<tr>
<td>Financial Dimension</td>
<td>• Managing your resources to live within your means, making informed financial decisions and investments, setting realistic goals, and preparing for short-term and long-term needs or emergencies</td>
</tr>
<tr>
<td>Environmental Dimension</td>
<td>• Understanding how your social, natural, and built environments affect the effects of your daily habits on the physical environment</td>
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Strategies

Change also becomes more achievable if you choose strategies that enhance your chance for success. Such strategies include monitoring; scheduling; investing in systems of accountability; abstaining; increasing or decreasing convenience; planning safeguards; detecting rationalizations and false assumptions; using distractions, rewards, and treats; pairing activities; and beginning with habits that directly strengthen self-control (8). Most successful habit change requires the coordination of multiple strategies to establish a single new behavior (8), and new habits, on average, take 66 days to form (12), so the more strategies used, the better.

Change your habits, change your life

Sometimes change takes a long time. Sometimes it requires repeated experiments and failures. But for ongoing betterment, the attempts are unquestionably worthwhile and one success often leads to another. When thinking about habits, wellness, and the health, well-being, and quality of life to which you aspire, consider the following: “Are you going to accept yourself or expect more from yourself?” “Are you going to embrace the present or consider the future?” and “Are you going to care about yourself or overlook yourself?”

Wellness is a dynamic, ever-changing, fluctuating process (13). It is a lifestyle, a personalized approach to living life in a way that allows you to become the best kind of person that your potentials, circumstances, and fate will allow. The past is history; the present and future lie in the choices you make today. Don’t worry about getting it perfect; just get it going, and become the best kind of person you can be.

References

What Can’t Be Taught
Ce qui ne s’enseigne pas

Establishing self-confidence through learned knowledge

Sara Watt

My first year of practice brought new challenges, adventure, and excitement. After graduating from WCVM in the spring of 2009, I had a brief stint of locum experience in the Okanagan Valley at a clinic I had volunteered with since my teens. It was a really great place to start, the vets there were very supportive and patient with me as I flipped through my small animal internal med notes to sort out my differential diagnosis and treatment plans. I could even say I felt they were a bit proud of me finally achieving my goal of becoming a veterinarian myself. It was a hard battle, 4 years of a Bachelor of Science, cleaning kennels and restraining pets during my summers off, then going through 2 interview processes before being accepted to vet med. I remember one of the vets asking me after I did not gain acceptance after my first interview, “Are you really sure you want to be a vet? You know it’s still a job right? Dentists earn way more.” But no, I had no intention of looking at human mouths all day, I wanted to be a vet.

Anyway, I digress. Once that summer came to an end, my partner and I moved to New Zealand with 1-year working visas, which were effortless to obtain being under the age of 35, and a license to practice by simply paying the relatively inexpensive annual registration fee to the NZ Veterinary Association. By writing the NAVLE exam here in Canada, no further examination was required to practice within the commonwealth, which includes NZ. I had always wanted to travel, and when there weren’t any permanent job opportunities in my home town after I graduated, I decided to take the opportunity to live and work abroad. It was a daunting experience, especially being a new grad, honing your skills, wondering if they do things the same as we do here at home. But I am really glad I went. And yes they do do things differently over there, sometimes a whole lot differently!

My first job I took basically over the phone, without seeing the clinic, without meeting the staff, and without seeing the area. I will never do that again! I lasted 2 weeks. Let’s just say that clinic was not for me; fortunately, NZ is really short on vets and there were plenty of other job opportunities. I learned to be patient and sort through the options until I found a position suitable for me and in a location where we wanted to live. After a month of looking around and traveling, seeing some of the different areas of the south island, we decided to plop down in a little farming town by the name of Culverden, just north of Christchurch on the mid-eastern side of the island. Culverden was home to 500 people and 500 dairy cows to each one of those people. The dairies there were enormous, all rotary milking parlors and grass-fed cows. There were very few left or right displaced abomasums and C-sections, I’m not too sure why, maybe because their cows and calves are smaller and fed differently. One thing I did see a lot of was frothy grass bloat. The dairy farmers there were in many cases relatively new to the dairy industry, having switched over from cattle and sheep farming. They really liked to stab their cows in the rumen to release the pressure, with a knife, not a trocar, but being frothy grass bloat, there wasn’t just gas that came exploding out of the hole. Approximately 50% of the cows later succumbed to peritonitis and died. I was only able to convince one farmer the whole year I was there to let me do a rumenotomy to help prevent the extent of abdominal contamination. He always called me after that and he was so happy his cows stopped dying. One farmer, but I guess that’s better than none, right? They did have some more advanced equipment that I had never seen before and honestly haven’t seen since come to think of it, such as a portable oxygen concentrator which uses room air to power the anesthetic machine, eliminating the need for an oxygen tank. I thought that was pretty neat, and it was especially handy when looking up a patient to an oxygen cage overnight and not having to worry about using up all the compressed gas.

Boar hunting was another thing the rural New Zealanders enjoyed doing, especially on weekends. I had several after-hours emergencies during which I had to stitch up torn hind limb muscles, flush wounds, and stem jugular vein hemorrhage. I often requested the help of the client in these afterhours situations, and I learned very quickly that some of the things we are comfortable seeing as vets is not something our clients are comfortable seeing, on their own pets especially. I saw many a pale face and instructed the odd burley hunter to have a seat on the floor while I finished up. Many of them swore to me they would never go boar hunting again after witnessing the surgery their beloved boar dog had to go through, and I don’t doubt that was true! It was fun working in New Zealand, yes they did things sometimes frustratingly differently, but I just stuck to my guns and I think that they taught me just as much as I taught...
them. That is something to remember; as a new grad yes you lack in experience, but you are full of knowledge.

Veterinary medicine is constantly changing, and the new grads gain new knowledge. For me, I was happiest working somewhere where my coworkers were willing to be not only mentors, but also willing to listen and learn from me. The best example I have of that is when I was casually sitting in on a stifle surgery my boss was performing, and just asking him for my own knowledge really, what his anesthetic protocol was. Our conversation went something like this: ‘So what was your pre-med?’ ‘Ace.’ Hmm I thought. ‘So what was your anesthetic induction agent?’ ‘Thiopental.’ Still confused, I asked ‘Okay so what do you have on hand for pain control?’ ‘He doesn’t need pain control, he’s sleeping.’ ‘What??’ I say in shock, then repeating what I was drilled numerous times during my anesthesia course at vet school, ‘Anesthesia is not analgesia!’ After scolding him, he calmly asked me what I would have done for pain control, then after the surgery I gave him a copy of the chapter on pain control from my textbook, which I don’t believe he actually read, but every time he did another surgery, he asked me what his pain control protocol should be and he did it.

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Communication: Touchy at-home treatment communication dilemmas

Myrna Milani

Multiple veterinary sources offer handouts practitioners can share with their clients. Among these are those that provide how-to instructions for clients who desire to do basic procedures, such as injecting certain medications or administering subcutaneous fluids, at home.

When Dr. Bernard first began sharing such handouts with her clients, she considered this a win-win for her, her clients, and her patients.

“I practice in a low-income area where many people live paycheck to paycheck. But my clients do care about their animals and they do try to do the best they can,” she explains. “Providing them with the wherewithal to do simple treatments at home like injecting medications or giving SQ fluids to a cat with renal problems is more than a convenience in some of these cases. It enables those people to provide care for their animals that they wouldn’t be able to afford otherwise.”

Meanwhile her colleague, Dr. Dougherty who practices in a more affluent area, considers these handouts beneficial for a completely different reason.

“There are times when doing routine, repetitive treatments in-house stresses the animal or the client sufficiently that it decreases the efficacy of the treatment. I’ve had several cases where it became stressful enough that clients started missing appointments or tried to convince me their animals no longer needed treatment even though I knew the animals did,” the practitioner comments. “When I gave those clients the option of treating their animals at home themselves, they were thrilled.”

However, Drs. Bernard and Dougherty soon realized that providing this service had a downside as well as an upside one that could create communication dilemmas for them. For example, it quickly became apparent to both practitioners that some clients desiring the service were less competent than others. Although Dr. Bernard’s client, Mr. Erikson, wanted to treat his rambunctious golden retriever at home for financial and convenience reasons, the elderly client lacked the physical ability to restrain the animal properly. Add that the client’s arthritic hands and failing vision made administration of medications of any kind an “iffy” proposition at best, and Dr. Bernard initially found herself in a difficult position.

“I wanted to acknowledge my client’s legitimate concerns and fulfill his wishes. But there was no way I could support his performing a procedure that potentially could put him and his animal at risk,” she explains. “It took me a while to figure out how to tell Mr. Erickson this in a way that wouldn’t jeopardize our clinician-client relationship.”

To accomplish this, Dr. Bernard began by acknowledging the legitimacy of Mr. Erickson’s desire to medicate his dog at home. Then she explained her concerns about her client’s and his animal’s safety. However, she did not end the discussion there. She also provided Mr. Erikson with a viable alternative. She would help him solicit help to restrain the dog from willing and able friends, and have one of her technicians who lives near him stop in to medicate the dog daily for a reasonable fee. In such a way, the veterinarian provided the client with a compromise that addressed his needs as well as those of his animal.

Dr. Doherty’s communication challenge takes the form of what he calls “Give ’em an inch and they’ll take a mile” clients.

“I fully support clients with terminally ill animals who want to make their animals’ last days as comfortable as possible. And I also accept that there are certain procedures many clients can do at home, such as change bandages or give injectable medical support of one kind or another to treat their animals with chronic problems,” he declares. “But it irks me when those same people expect me to dispense medications for a new or even recurrent problem in an animal I haven’t seen in ages. After one client tried to badger me into dispensing medication for a relative’s animal I’d never even seen, I decided I had to come up with a standard response to avoid saying something to these clients that I’d regret.”

Dr. Milani is a behavior and bond practitioner, teacher, and author of several books on the interaction of animal behavior, health, and the human-animal relationship.

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After trying several different approaches, Dr. Doherty decided that the one that worked best for him was the simplest as well as most professional one. He told these people he could not do as they asked because it would be poor veterinary medicine and a disservice to them and their animals to do so.

“I know you think Sherwood is perfectly healthy except for his ears bothering him again, and I certainly hope that’s true” he tells Ms. Rasmussen. “But it’s been more than a year since I’ve seen him. And while it’s possible he has the same kind of infection he did the last time, he might not. If he doesn’t, it’s not just that the wrong medication might not work. It could make his infection worse and much more difficult and costly to treat.”

The third at-home treatment challenge is one practitioners in all areas increasingly may encounter: dispensing certain drugs or apparatus for home use in a household in which the potential for abuse is suspected or known to exist in one of its residents. Unlike clients such as Mr. Erikson and Ms. Rasmussen who fully intend to use any medications and apparatus from the veterinarian to treat an animal, substance abusers want any medication or equipment for their own use. This obviously can create problems for practitioners that have implications for their patients’ well-being.

In general, substance abusers who steal medications or needles prescribed for animals belonging to other family members or housemates are secretive about this. Some may feel embarrassed that their addiction causes them to behave in such a deceitful manner. Additionally, most abusers do not want to compromize what they perceive as a reliable source of medication or useful medical apparatus. But regardless of the abuser’s specific motivation, it may result in liquid medications intended for the animal being surreptitiously removed from vials and replaced with water, or tablets replaced with over-the-counter look-alikes. Sterile needles meant to inject medications or fluids to treat the animal may be taken and replaced with used ones.

When this occurs, practitioners may assume that clients are treating their animals with specific amounts of specific medications and administering these using sterile apparatus when this may not be the case. When their patients do not respond to their prescribed medications as anticipated, Drs. Barnard and Dougherty used to increase the dosage or switch to a different medication. If the animal displayed symptoms related to contamination of any administration apparatus, the veterinarians lost valuable time and sleep trying to determine the source of the problem as well as treating the animal for its negative results.

They also felt obligated to replace the contaminated apparatus at no charge. When the same circumstances arose again, they became frustrated and angry.

Based on these unrewarding experiences, the practitioners once again developed a basic communication protocol to accompany their medical ones to ensure their patients safety and well-being. Instead of dispensing more or other controlled drugs and apparatus for home use when problems arise, they immediately hospitalize the animal to determine what is going on. If the animal responds as expected to the prescribed treatment properly administered in their facilities then they knew that, whatever the problem was, it was related to something going on in the home environment.

When they discharge such an animal to the owner’s care, the veterinarians’ remarks avoid blame or speculation in favor of focusing on the animal’s well-being.

“Because Chelsey didn’t respond to the medication when you gave it at home, I want to medicate her here daily or send a skilled technician to medicate her for you at home,” Dr. Bernard tells her client.

If the client protests about the added expense, she also notes that she could dispense a different, but unfortunately less effective nonnarcotic oral medication for home use if the client would prefer this.

“This isn’t a perfect solution, but we can only work with what we know for sure,” Dr. Doherty sums up these difficult situations. “No matter how suspicious we may be about the potential for human drug abuse, all we know is that at-home treatment with that drug or the way of administering it isn’t working in that client’s home and that’s jeopardizing the animal’s health. It’s our responsibility to do the best we can to help the animal within those limits, not to identify and out a substance abuser.”

Fortunately, touchy situations related to at-home controlled drug administration or injected treatments of any kind comprise the minority. But when they do occur, they can take up a disproportionate amount of practitioners’ time unless a standard protocol exists to address them. But although most practitioners routinely master protocols that strictly address the animal’s physical needs, they may assume that the words that will enable them to accomplish the sometimes delicate client communication skill associated with these will magically occur to them. Unfortunately, though, sometimes when they need her the most, the muse of quality client communication lets them down.
1. **A)** AST and ALP are not liver-specific. ALT and AST are leakage enzymes.

   **A)** L’AST et la PA ne sont pas des enzymes spécifiques au foie. L’ALT et l’AST sont des enzymes qui fuient.

2. **B)** The most common cause of endodontic disease in dogs is dental trauma, with a tooth being fractured and secondary pulpal exposure. Radiographically, signs of chronic endodontic disease include periapical or apical lysis and large endodontic canals compared to contralateral canals. This is because inflammatory products leak into the periapical tissues and cause resorption of the periapical bone or apex of the root itself. The endodontic canal (pulp) may be larger in the affected tooth compared to the contralateral normal tooth; this is due to a failure of dentin deposition secondary to early pulpal necrosis in a young dog with a fractured tooth. Endodontic therapy, including vital pulpotomy, conventional endodontic therapy, and surgical endodontic therapy, is a viable alternative to extraction in dogs with endodontic disease.

   **B)** La cause la plus fréquente de maladie endodontique chez le chien est un traumatisme à une dent, lorsque celle-ci est fracturée et secondairement exposée. Du point de vue radiographique, les signes de maladie endodontique chronique comprennent une lyse périapicale ou apicale et de grands canaux endodontiques par comparaison aux canaux controlatéraux. Cela est dû aux produits inflammatoires qui fuient dans les tissus périapicaux et causent la résorption de l’os périapical ou de l’apex de la racine elle-même. Le canal endodontique (pulpaire) peut être plus grand dans la dent affectée par comparaison à la dent controlatérale normale; cela est dû à un défaut de dépôt de la dentine, secondairement à une nécrose précoce de la pulpe chez un jeune chien qui présente une dent fracturée. Le traitement endodontique, incluant une pulpotomie vitale, un traitement endodontique conventionnel et un traitement endodontique chirurgical, est une solution de remplacement viable à l’extraction chez le chien souffrant de maladie endodontique.

3. **A)** Leydig or interstitial cell neoplasms of the testes are typically soft and yellow. Seminomas tend to be firm and white to pink gray, and Sertoli cell tumors are usually firm, white, and lobulated. Perianal gland neoplasms are usually benign (adenomas), so metastasis to the testis is unlikely.

   **A)** Les néoplasmes testiculaires des cellules de Leydig ou interstitielles sont de façon caractéristique de consistance molle et de couleur jaune. Les séminomes ont tendance à être durs et de couleur blanche à rose; les tumeurs des cellules de Sertoli sont habituellement jaunes, blanches et lobulées. Les néoplasmes des glandes périanales sont habituellement bénignes (adénomes) de sorte que les métastases aux testicules sont peu probables.

4. **C)** Fescue is the only forage in the group above that is known to be infected with an endophyte that produces toxins capable of causing the described problems.

   **C)** La fétuque est le seul fourrage du groupe qui est reconnu pour être infecté avec un endophyte qui produit des toxines capables de causer les troubles décrits.

5. **C)** Blind abomasal pexies are recommended if displacement is to the left side of the abdomen, there are unlikely to be abdominal adhesions, and a gravid uterus will not be positioned by the right cranioventral abdomen, such as occurs after the fifth month of gestation. Metritis does not preclude these techniques, and recovery may be enhanced since uterine drainage occurs in dorsal recumbency. This is the only position in which the procedure can be performed.

   **C)** Les abomasopexies à l’aveugle sont recommandées si le déplacement est du côté gauche de l’abdomen; il est peu probable qu’il y ait des adhérences abdominales et un utérus gravide ne sera pas placé en position cranioventrale droite dans l’abdomen, tel qu’il se produit après le cinquième mois de gestation. Une métrite n’empêche pas ces techniques et la récupération peut être stimulée puisque le drainage de l’utérus se produit en décubitus dorsal. C’est la seule position dans laquelle l’intervention peut être pratiquée.
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