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**Contributors**

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Les «Directives à l'intention des auteurs» sont disponibles en ligne (www.veterinairesaucanada.net).
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Complementary and alternative veterinary medicine

Médecine vétérinaire complémentaire et parallèle

Complementary and alternative veterinary medicine (CAVM) is “an inclusive term that describes treatments, therapies, and/or modalities that are not accepted as components of mainstream veterinary education or practice, but that are performed on animals by some practitioners. While these treatments, therapies and/or modalities often form part of veterinary postgraduate education, study and writing, they are generally viewed as alternatives or complementary to more universally accepted treatments, therapies and modalities” (1).

There has been considerable recent interest in CAVM. This upsurge in enthusiasm for CAVM has been associated with increasing use of CAVM in human medicine and interest on the part of animal owners who want for their animals similar health care to that available for themselves. Increased demand for “natural” remedies and development of interest in these areas by some veterinarians are also factors. Growth of these new fields in veterinary practice has, understandably, attracted the attention of professional organizations and regulators. In 2017, the Canadian Veterinary Medical Association (CVMA) held a national issues forum on CAVM at its Annual Meeting in Prince Edward Island. The focus of the forum was “Alternative Medicine no Longer Alternative?” Subsequently, the CVMA updated its position on this subject (CVMA, January 2020).

One of the difficulties in regulation of CAVM is that the body of knowledge/practice to which this type of medicine is complementary or alternative has borders that change over time and cannot be precisely defined. In human medicine these boundaries are more easily defined because “Standard care is what medical doctors, doctors of osteopathy, and allied health professionals, such as nurses and physical therapists, practice. Examples of alternative practices include homeopathy, traditional medicine, chiropractic, and acupuncture” (2). CAVM practices include the above as well as manual therapy, laser therapy, nutraceuticals, and dietary supplements (1,3). A major difference between the human and animal medical situations is that the training, licensing, and practice operations of phys-
ÉDITORIAL

Un autre problème est que, bien que de nombreux médecins vétérinaires aient reçu une formation en médecine parallèle, il y a un manque de clarté sur la formation adéquate et la manière dont la compétence est validée. Le College of Veterinarians of Ontario considère que la réussite d’un programme de certificat d’études supérieures en traitement des animaux est la norme de formation appropriée pour ceux qui souhaitent effectuer des interventions de médecine complémentaire ou parallèle sur des animaux, et cite le programme d’agrément par l’American Veterinary Chiropractic Association comme exemple de programme approprié (1). L’ACVM « appuie le concept de la certification par l’American Board of Veterinary Specialties (ABVS) pour les modalités de traitement de MVCP fondées sur des preuves scientifiques solides quant à leur innocuité et leur efficacité », mais il n’existe actuellement aucune organisation de spécialité vétérinaire reconnue par l’ABVS en ce qui a trait à la MVCP. Il semble que l’information sur la sécurité et l’efficacité de la MVCP et sur les mécanismes de plusieurs types de MVCP est insuffisante et que de la recherche et des essais cliniques s’avèrent nécessaires. Il faudrait également évaluer les différents aspects de la MVCP individuellement, plutôt que de les regrouper.

Les associations professionnelles nationales au Canada, aux États-Unis, en Australie et en Nouvelle-Zélande ont toutes des énoncés de position similaires sur la MVCP. Ces énoncés stipulent qu’une rigueur fondée sur des preuves s’impose, tout comme des connaissances et une formation suffisantes pour les
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**Références**

1. Énoncé de position du CVO. The Practice of Complementary and
   Alternative Veterinary Medicine. Disponible au : https://cvo.org/
   CVO/media/College-of-Veterinarians-of-Ontario/Resources%20
   and%20Publications/Position%20Statements%20and%20Guidelines/
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**Carlton Gyles**

( Les opinions exprimées dans cet article sont celles du rédacteur
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Ethical question of the month – January 2020

You are presented with a healthy 1-year-old crossbred farm dog with a moderate lameness in the right front leg. The dog runs loose around the farm. The dog is mildly weight-bearing on the leg but is sore on palpation. Radiographs reveal a non-displaced fracture of the radius just above the carpus. The owner is uninterested in surgical stabilization, so you cast the leg and send the dog home on pain medication. Two days later the owner returns, as the dog has chewed off the cast. You re-cast the leg and put an Elizabethan collar on the dog. Two days later the owner returns as the dog has somehow removed the collar and again chewed off the cast. The owner is frustrated over the mounting costs and repeated trips to your clinic. The owner suggests keeping the dog in a small pen in the barn without casting the leg and seeing if the leg can heal provided the dog has limited mobility. You believe this is a reasonable approach and decide to stop the pain medication to further reduce activity. You believe in situations such as this that pain serves as a natural signal to encourage resting an injury so it can properly heal. Your younger associate completely disagrees with this approach and feels denying pain medication to an animal with a fracture is inhumane and unprofessional. How should you respond?

Pain management of dog — A comment

We all need to be learning every day. I would recommend a conversation over the X-rays with both veterinarians to be sure of their points-of-view. In conjunction with the owner’s approval, I would also recommend a call to a third party, likely an appropriate member of the Ontario Veterinary College, an orthopedic expert to evaluate and follow that advice as to appropriate drug therapy (pain/sedation and length of time) if it is agreed simple cage rest/activity restriction is a potential solution.

Submitted by Clayton MacKay, DVM, Veterinary Consulting

An ethicist’s commentary on pain management of dog

I have a strong tendency to agree with the junior partners in the practice. A recent book referred to pain as “the worst of all evils.” We are privileged to live at a time in which pain can be controlled. In my view, it ought to be controlled wherever possible. The suggestion that the pain not be controlled and the animal left to run around is unacceptable and not worthy of veterinary medicine.

Pain is particularly problematic in animals as they lack the ability to understand why it is happening and what can stop it. Spinoza pointed out a long time ago that understanding the source of pain serves to mitigate it. For this reason, we are obligated to control pain pharmacologically and let the animals enjoy peace.

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L’usage du présent article se limite à un seul exemplaire pour étude personnelle. Les personnes intéressées à se procurer des réimpressions devraient communiquer avec le bureau de l’ACMV (hbroughton@cvma-acmv.org) pour obtenir des exemplaires additionnels ou la permission d’utiliser cet article ailleurs.
The history of acknowledgment of animal pain by the scientific community is extremely spotty and sporadic. During the late 1980s, neither animals nor infants were considered capable of feeling pain. At a conference I attended on animal pain, I took issue with a scientist who claimed that animals and babies were incapable of feeling pain. Babies experienced open-heart surgery with no pain control at all. I advised this scientist to study the subsequent history of infants who received surgery without any anesthesia. As I suspected, such people grew up with a strong tendency to develop chronic pain. This individual, a psychiatrist, asked me if I had been circumcised and if so, did I remember it at all. I had no memory of the experience, so he claimed the pain did not matter. When I published his claim in a speech, the general public was incensed, and very shortly thereafter demanded pain control for babies and animals.

By the end of the 1990s, the pediatric and veterinary communities had begun to abandon the denial of pain in infants and in animals. This resulted from societal pressure refusing to accept these concepts. In the social mind, animal and child pain were far more horrendous than pain in adults. And this is as it should be, although far too late. As the moral status of animals and children has increased, concern with their experiences has correlatively increased. And this is again as it should be, given the lack of understanding of pain in these populations.

**Ethical question of the month — April 2020**

The Coronavirus disease 2019 (COVID-19) is suspected to have originated in a wet market in China. Recent evidence demonstrates that similar coronaviruses may cross species barriers. This has raised concerns at animal research institutions that a person unknowingly infected with COVID-19 could infect the research animals in the facility. Without established tests for this infection in various animal species, an infected animal population may be difficult to identify. Not only could a subclinical or clinical infection affect experimental outcomes, but it potentially could serve as a reservoir of infection for students and staff working in the facility. Essentially quarantining the animals in the facility would result in a significant loss of time and money invested in research projects currently underway or planned. At the same time, infecting a population of research animals would have its own serious consequences. **Is there an ethically sound approach to this dilemma given all the unknowns that currently exist regarding this new coronavirus epidemic?**

**Question de déontologie du mois — Avril 2020**

La maladie à coronavirus 2019 (COVID-19) est présumée provenir d’un marché de fruits de mer et d’animaux vivants en Chine. Des données récentes démontrent que des coronavirus similaires peuvent traverser la barrière des espèces. Cette situation soulève des inquiétudes dans les centres de recherche : on se demande si une personne infectée sans le savoir par le virus du COVID-19 pourrait infecter les animaux utilisés pour la recherche dans l’établissement. Sans tests établis pour détecter l’infection chez diverses espèces animales, il peut être difficile de déterminer si une population animale est infectée ou non. Une infection subclinique ou clinique pourrait affecter les résultats expérimentaux, mais aussi potentiellement servir de réservoir d’infection pour les étudiants et le personnel travaillant dans l’établissement. La mise en quarantaine des animaux entraînerait une perte importante de temps et d’argent investi dans les projets de recherche en cours ou prévus. De plus, l’infection d’une population d’animaux de recherche aurait ses propres conséquences importantes. **Existe-t-il une approche éthique de ce dilemme compte tenu de tout ce qui demeure inconnu à l’heure actuelle concernant cette épidémie de nouveau coronavirus?**

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 Dr 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.
1. Which of the following is a sign of calcium toxicity during fluid therapy?
   A. Bradycardia
   B. Tachycardia
   C. Tetany
   D. Hypertension

2. Which of the following is the most common cause of esophageal hypomotility in dogs?
   A. Hypothyroidism
   B. Hypoadrenocorticism
   C. Idiopathic megaesophagus
   D. Myasthenia gravis

3. Which of the following is INCORRECT regarding feline panleukopenia virus (FPV)?
   A. Infection is severe in susceptible adult cats.
   B. Vaccination is highly effective for prevention.
   C. FPV infects felines, raccoons, ferrets, and mink.
   D. FPV can survive in the environment for more than 1 year.
   E. Leukopenia can be profound and lasts 2 to 4 days.

4. Which of the following is NOT characteristic of a central nervous system lesion?
   A. Proprioceptive deficits are present.
   B. Seizures or altered consciousness are present.
   C. Cranial nerve deficits are present with no other clinical signs.
   D. Cranial nerve deficits are present with limb signs.
   E. Upper motor neuron signs are present.

---

1. Lequel des problèmes suivants est un signe de toxicité par le calcium lors de fluidothérapie?
   A. Bradycardie
   B. Tachycardie
   C. Tétanie
   D. Hypertension

2. Lequel des problèmes suivants est la cause la plus fréquente d’hypomotilité de l’œsophage chez le chien?
   A. Hypothyroïdie
   B. Hypoadrénocorticisme
   C. Mégaœsophage idiopathique
   D. Myasthénie grave

3. Lequel des énoncés suivants est INCORRECT à propos du virus de la panleucopénie féline?
   A. L’infection est sévère chez les chats adultes sensibles.
   B. La vaccination est très efficace comme moyen de prévention.
   C. Le virus infecte les félins, les ratons laveurs, les furets et les visons.
   D. Le virus peut survivre dans l’environnement pendant plus de 1 an.
   E. La panleucopénie peut être marquée et durer de 2 à 4 jours.

4. Lequel des signes suivants N’EST PAS caractéristique d’une lésion du système nerveux central?
   A. Des déficits proprioceptifs sont présents.
   B. Des convulsions ou une conscience altérée sont présentes.
   C. Des déficits relatifs aux nerfs crâniens sont présents, sans autre signe clinique.
   D. Des déficits relatifs aux nerfs crâniens sont présents, accompagnés de signes touchant les membres.
   E. Des signes relatifs au neurone moteur supérieur sont présents.
5. A 20-year-old gray warmblood gelding presents for weight loss, dysuria, and inappetence. On examination, large, coalescing melanomas of the sheath and penile shaft are found. Findings from a rectal examination are normal. Abdominal ultrasound shows masses in the spleen. The most likely diagnosis for the masses in the spleen is which of the following?
   A. Melanoma metastases
   B. Hemangiosarcoma
   C. Lymphosarcoma
   D. Splenic hematomas

5. Vous examinez un cheval hongre Warmblood gris âgé de 20 ans pour une perte de poids, de la dysurie et de l’inappétence. Vous constatez de grands mélanomes coalescents sur le fourreau et le pénis. Les résultats de l’examen rectal sont normaux. Une échographie abdominale montre des masses spléniques. Laquelle des affections suivantes constitue le diagnostic le plus probable pour les masses observées sur la rate?
   A. Métastases dues aux mélanomes
   B. Hémangiosarcome
   C. Lymphosarcome
   D. Hématomes spléniques

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A Reflection on Saskatoon’s Students of the CVMA (SCVMA) Symposium
Aperçu Symposium des étudiants de l’ACMV à Saskatoon

This past January 17 and 18, over 230 veterinary medical students from the 5 Canadian veterinary colleges congregated in −40°C weather in Saskatoon, Saskatchewan at the Western College of Veterinary Medicine (WCVM) for the 33rd edition of the SCVMA Symposium. This annual conference rotates yearly between the colleges and is organized for students, by the students. The theme for this conference was “The Progressive Future of Veterinary Medicine: Wellness, Welfare, and Well-being”; encompassing currently relevant themes of the industry and featured 3 keynote presentations, 19 clinical presentations, 14 wet labs, 6 tours, and a variety of social events.

This 2-day conference welcomed students Thursday night at Outlaws, a local bar where they could mingle. Students were up early Friday morning when Symposium officially began. The main hall was bustling with activity as students ate breakfast and checked out the exhibitor area featuring Symposium sponsors: Hills, SunLife, True North Financial Services Inc., Purina, and the Canadian Veterinary Medical Association (CVMA). Shortly after breakfast, students made their way to lectures. Lectures addressed topics of animal welfare and were facilitated by nationally renowned researchers and presenters. Topics included a discussion of clinician welfare presented by a social worker, animal welfare from a legal perspective, and even a lecture on client welfare in relation to euthanasia.

A falcon is put on display during one of the tours.

Student Rachel Loppe (UCVM), left, and Emma Bush (AVC) attend the Bee Lab.

Les étudiantes Rachel Loppe (UCVM), à gauche, et Emma Bush (AVC) participent à l’atelier sur les abeilles.
Following lunch, students attended their selected wet lab. Topics ranged from bees to fish to small animal dental health; from bovine reproduction to CPR training to equine acupuncture. Students were able to practice hands-on, in small ratios of students to educators and working in groups. The most popular wet lab was “Advanced Feline Soft Tissue Surgery” with over 60 students.

To close the day, students were invited to a “Prairie Dinner” that featured a presentation by keynote speaker Albertan Dr. Cody Creelman. The veterinarian, practice owner, and self-proclaimed “digital storyteller” spoke about managing social

Après le dîner, les étudiants ont assisté à l’atelier qu’ils avaient choisi. Les sujets allaient des abeilles aux poissons en passant par la santé dentaire des animaux de compagnie, et de la reproduction bovine à la formation en RCR en passant par l’acupuncture équine. Les étudiants ont pu s’exercer en petits groupes supervisés par un éducateur et travailler ensemble. L’atelier pratique le plus populaire a été celui sur la chirurgie avancée des tissus mous chez les chats, auquel plus de 60 étudiants ont participé.

Pour terminer la journée, les étudiants ont été invités à un « souper typique des Prairies » qui comprenait une présentation du conférencier d’honneur albertain, le Dr Cody Creelman.
Propriétaire de pratique et « conteur de l’ère numérique » autoproclamé, ce dernier a parlé de la gestion de notre présence sur les réseaux sociaux en tant que médecins vétérinaires en adoptant une politique d’honnêteté et de transparence. Cette conférence a été bien reçue.

Les étudiants se sont aussi réveillés tôt samedi matin et ont bravé le froid de Saskatoon pour profiter d’expériences culturelles dans une variété d’entreprises locales. Parmi les excursions offertes, certaines comprenaient la construction de tipis, une randonnée en raquettes, des visites au zoo et au musée d’art Remai ainsi que des rencontres avec des chiens et des faucons.

Tous les étudiants se sont réunis à nouveau pour le dîner, avant de partir assister aux deux présentations principales restantes. Le premier conférencier était le Dr Terry Whiting, responsable de la santé et du bien-être des animaux d’Agriculture et Alimentation Manitoba (Direction des services vétérinaires), qui a partagé ses expériences de travail dans la gestion du bien-être animal et ses effets sur son bien-être mental et sa santé. Le Dr. Whiting a en outre donné des conseils aux étudiants sur la meilleure façon de prendre soin d’eux-mêmes et de leur santé mentale grâce à une politique d’ouverture, de soutien mutuel et de recherche d’aide en cas de besoin. Son exposé a été suivi par celui de la Dr. Keri Hudson-Reykdal de l’émission « Dr. Keri: Prairie Vet » diffusée sur la chaîne Animal Planet. La Dr. Hudson-Reykdal a parlé du bien-être en médecine vétérinaire moderne et de l’influence et des ramifications des médias sociaux sur les vétérinaires praticiens, en particulier ceux qui expriment publiquement leurs opinions politiques.

La journée s’est terminée par un banquet formel au musée d’art Remai. Le discours de clôture a été prononcé par la CVMA présidente Dr. Melanie Hicks et Vanessa Fussell, organisatrice du Symposium, étudiante de troisième année au WCMV et membre du comité des étudiants de l’ACVM.

Attending Symposium is an amazing opportunity for veterinary students to engage with one another and learn about different sectors of the field. Next year, the 2021 Symposium will be held in Guelph, Ontario at the Ontario Veterinary College, January 15 and 16. If you are interested in learning more, please visit the website (www.canadianveterinarians.net) or contact the CVMA (symposium@cvma-acvm.org).

(by Emma Bush, Senior Representative for Atlantic Veterinary College)
It is important to ensure your clients’ pets have reliable forms of identification in the event they become lost.

The Canadian Veterinary Medical Association (CVMA) supports the permanent identification of animals and recommends the use radio-frequency identification (RFID) products (microchips, transponders) that conform to the International Standards Organization (ISO) standard of technology. Read the CVMA’s Microchip Animal Identification position statement under the Policy & Advocacy tab of the website.

The CVMA recommends veterinarians use RFID products that have been successfully reviewed by the National Companion Animal Coalition (NCAC) and appear on the NCAC list of recognized products, which can be found on the NCAC website (www.ncac-cnac.ca).

World Veterinary Day is April 25, 2020

World Veterinary Day takes place globally on April 25, 2020. This event aims to highlight and promote the different facets of the work performed by veterinarians all over the world and to raise awareness of their contribution to improve animal health and welfare, as well as public health. Each year, a different topic is selected by the World Veterinary Association (WVA) and the World Organisation for Animal Health (OIE), the organizers of the event.

Journée mondiale vétérinaire le 25 avril 2020

La Journée vétérinaire mondiale sera célébrée à l’échelle mondiale le 25 avril 2020. Cet événement vise à mettre en évidence et à promouvoir les différentes facettes du travail effectué par les médecins vétérinaires du monde entier et à sensibiliser le public à leur contribution à l’amélioration de la santé et du bien-être des animaux, ainsi que de la santé publique. Chaque année, un thème différent est choisi par la World Veterinary Association (WVA) et l’Organisation mondiale de la santé animale (OIE), les organisateurs de l’événement.
Find Out How the CVMA Supports Your Business and Saves You Money

The CVMA’s priorities are providing leadership, advancing Canadian veterinarians’ interests, and influencing government and policy makers on issues affecting you and animal health and welfare. As CVMA members, you support these priorities but your membership also enables us to research and provide you with ways to support your business and save you money.

All CVMA members can benefit from a large range of services, privileges, and discounts. Below are benefits and services available to you FREE OF CHARGE:

1. A FREE 30-day trial of Sofie, a search tool, created by veterinarians for faster, easier access to current and credible veterinary medical information. Also, the CVMA’s partnership with LifeLearn Animal Health entitles CVMA members to a 10% savings on Sofie and 3 other LifeLearn Products; use custom WebDVM websites to improve search engine optimization, use ALLYDVM to track, schedule and automate appointment reminders, and access ClientEd for an online library of pet health articles.

2. A FREE human resources document bundle through CVMA’s partner HRdownloads! Save time and get support from HR experts who know what the Canadian veterinary industry needs. Your free bundle includes:
   - Veterinary Technician Job Description
   - Professional Accreditation Policy
   - Workplace Hazardous Materials Information System (WHMIS) 2015 Compliance Policy (GHS)
   - Written Warning Letter
   - Employee Performance Review.

HRdownloads also provides CVMA members with a 10% discount on other cost-effective and time-saving documentation, live HR support by senior HR advisors, online surveys, training solutions for HR efficiency, and more!

3. A FREE Career and Business Toolkit. This CVMA online Toolkit focuses on personal financial management, veterinary business management and client management and includes links to FREE online business, marketing and communications and human resources courses, a booklet containing simple checklists you should be following for effective practice management, cost of living comparisons across Canada, and automated appointment reminders, and access ClientEd for an online library of pet health articles.

FREE OF CHARGE:

1. Un essai GRATUIT de 30 jours de Sofie, un outil de recherche créé par des médecins vétérinaires pour un accès plus rapide et plus facile à de l'information médicale vétérinaire à jour et fiable. De plus, le partenariat de l'ACMV avec LifeLearn Animal Health permet aux membres de l'ACMV d'économiser 10 % sur Sofie et trois autres produits de LifeLearn : WebDVM pour des sites Web personnalisés qui améliorent l'optimisation pour les moteurs de recherche, ALLYDVM pour suivre, planifier et automatiser les rappels de rendez-vous, et ClientEd pour accéder à une bibliothèque en ligne d'articles sur la santé des animaux de compagnie.

2. Un ensemble GRATUIT de documents sur les ressources humaines par l'entremise du partenaire de l'ACMV HRdownloads. Gagnez du temps et obtenez le soutien d'experts en RH qui savent ce dont l'industrie vétérinaire canadienne a besoin. Votre ensemble gratuit comprend les documents suivants :
   - Description du poste de technicien vétérinaire
   - Politique d'agrément professionnel
   - Politique de conformité (SGH) du Système d'information sur les matières dangereuses utilisées au travail (SIMDUT) 2015
   - Lettre d'avertissement écrit
   - Évaluation du rendement des employés

HRdownloads offre également aux membres de l'ACMV de bénéficier d'un rabais de 10 % et d'obtenir de la documentation utile qui permet de sauver du temps, du soutien en direct par des conseillers en ressources humaines chevronnés, des sondages en ligne, des solutions de formation pour améliorer l'efficacité en ressources humaines, et plus encore!

3. Une boîte à outils pour la carrière et l'entreprise GRATUITE. Cette boîte à outils en ligne de l'ACMV est axée sur la gestion des finances personnelle, la gestion des affaires vétérinaires et la gestion des clients, et comprend des liens vers des cours GRATUITS en ligne sur les affaires, le marketing, les communications et les ressources humaines, un livret contenant des listes de contrôle simples à suivre pour une gestion efficace des pratiques, des comparaisons du coût de la vie partout au Canada, ainsi que des guides, des conseils et des articles pour aider votre pratique à réussir. Des ressources supplémentaires pertinentes pourraient être ajoutées s’il y a lieu.
as well as guides, tips, and articles all aimed to help your practice succeed. Additional resources will be posted as their relevance is determined.

4. **FREE CE courses** through the CVMA’s online education portal. CVMA members can access over 800 e-learning sessions and education resources from veterinary experts and educational institutions around the world. You can select sessions based on specialty, accreditation, minimum duration, education type, free or paid, and the tracker tool records your completions.

5. **FREE general legal advice** through VetLaw™, the CVMA’s online legal advice column.

6. **A FREE CVMA Source Guide** serving as a valuable reference tool to your national association, the Canadian veterinary community, veterinary specialty groups and organizations, and industry suppliers. Within this guide, you’ll also find a complete listing of CVMA member benefits and privileges, national issues and animal welfare position statements and awards and honors information recognizing your colleagues’ achievements. You can also use this guide to contact peers, colleagues, and classmates. The CVMA Source Guide contains a listing of CVMA boards, committees and representatives, national and international veterinary medical associations, veterinary colleges and national species-specific groups as well.

Below is a list of some of the **discounts** that CVMA members can also take advantage of:

1. **Moneris** and **MyVetStore** offer CVMA members preferred pricing.
2. **Petcard** offers CVMA members exclusive special benefits, incentives and rewards.
3. **Save up to 50%**, with rates averaging between 5% to 20% better than other online hotel booking services, with **CVMA Hotel Discount Program**.
4. **Save up to 44%** off regular individual membership rates with the **CVMA — GoodLife Fitness Corporate Discount Program**.

For a complete listing of CVMA member benefits and services, visit the website (www.canadianveterinarians.net). If you require more information, email the CVMA (admin@cvma-acmv.org).


5. **Des conseils juridiques généraux GRATUITS** par la rubrique en ligne «Le droit vétérinaireMC» de l’ACMV.


Voici d’autres rabais dont les membres de l’ACMV peuvent également profiter :

1. **Moneris** et **MaVitrineVétérinaire** offrent aux membres de l’ACMV des tarifs préférentiels.
2. **Petcard** offre aux membres de l’ACMV des avantages spéciaux, des incitatifs et des récompenses exclusives.
3. **Le programme de rabais hôteliers de l’ACMV** permet aux membres d’économiser jusqu’à 50% sur l’hébergement, avec des tarifs en moyenne de 5 à 20% plus avantageux que ceux des autres services de réservation d’hôtel en ligne.
4. **Économisez jusqu’à 44%** sur les tarifs réguliers d’adhésion individuelle avec le **programme de rabais de l’ACMV chez Énergie Cardio/GoodLife**.

Pour consulter la liste complète des avantages et services offerts aux membres de l’ACMV, visitez notre site Web (www.veterinairesaucanada.net). Si vous avez besoin de plus amples renseignements, envoyez-nous un courriel (admin@cvma-acmv.org).
Each year, the Students of the Canadian Veterinary Medical Association (SCVMA) surveys recent graduates from the 5 Canadian veterinary schools. The goal of this survey is to better understand the current conditions in the Canadian veterinary workplace, specifically for new graduates. For 2019, there were 216 participants with a response rate of 68%. The results are below for DVM students, recent graduates and the veterinary profession to view. Please note, not every participant responded to every question.

The respondents were asked to describe the location where they grew up, as well as other questions about their demographic such as college of graduation.

**Figure 1.** Location of where students were primarily raised ($n=201$).

Of those respondents living in a town or city, approximately 39% were from towns smaller than 50 000, whereas the rest came from cities with populations greater than 200 000.

**Figure 2.** School of graduation ($n=176$).
Employment data

Graduates were questioned about their current positions, search methods used to secure employment and various other matters. A total of 71% of respondents secured their job prior to graduating with the majority continuing to work with the same employer. 94% are still working within the veterinary field (n = 173) while the remaining are pursuing further education, on maternity leave or felt that there was too much debt to continue in the field.

Figure 3. Job search methods that resulted in employment (n = 158).

<table>
<thead>
<tr>
<th>Search method</th>
<th># of respondents</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Networking</td>
<td>36</td>
<td>23%</td>
</tr>
<tr>
<td>Provincial veterinary medical association classifieds</td>
<td>28</td>
<td>18%</td>
</tr>
<tr>
<td>Worked there as an undergraduate</td>
<td>24</td>
<td>15%</td>
</tr>
<tr>
<td>Other</td>
<td>24</td>
<td>15%</td>
</tr>
<tr>
<td>Internships</td>
<td>20</td>
<td>13%</td>
</tr>
<tr>
<td>CVMA/The Canadian Veterinary Journal classifieds</td>
<td>16</td>
<td>10%</td>
</tr>
<tr>
<td>Internet searches</td>
<td>10</td>
<td>6%</td>
</tr>
</tbody>
</table>

The figure below shows the current employment type for new graduates within the veterinary profession. Most graduates are employed in a private/clinical practice and overall, 52% of new graduates are satisfied with their current job.

Figure 4. Current employment type for new graduates within the veterinary profession (n = 148).

| Government                                         | 48               | 33%|
| Industry/Commercial                                | 40               | 28%|
| Internship/Residency                               | 4                | 3% |
| Private/Clinical practice                          | 54               | 37%|

The figure after indicates the amount of time respondents spend treating various animal species. Compared to last year, graduates spent more time treating small animal, less time with equine and bovine species, and more time practicing porcine medicine.

Données relatives à l’emploi

Les diplômés ont été interrogés sur leur poste actuel et les méthodes de recherche utilisées pour trouver un emploi. Au total, 71 % des répondants ont décroché leur emploi avant d’obtenir leur diplôme, la majorité continuant de travailler avec le même employeur, et 94 % travaillent toujours dans le domaine vétérinaire (n = 173) tandis que les autres poursuivent des études complémentaires, sont en congé de maternité ou ont estimé qu’ils avaient trop de dettes pour poursuivre dans le domaine.

Figure 3. Méthodes de recherche d’emploi ayant mené à l’embauche (n = 158).

<table>
<thead>
<tr>
<th>Méthode de recherche</th>
<th>Nombre de répondants</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Réseautage</td>
<td>36</td>
<td>23%</td>
</tr>
<tr>
<td>Annonces de l’association provinciale de médecine vétérinaire</td>
<td>28</td>
<td>18%</td>
</tr>
<tr>
<td>Emploi au même endroit durant les études</td>
<td>24</td>
<td>15%</td>
</tr>
<tr>
<td>Autre</td>
<td>24</td>
<td>15%</td>
</tr>
<tr>
<td>Stages</td>
<td>20</td>
<td>13%</td>
</tr>
<tr>
<td>Annonces de l’ACMV ou parues dans La RVC</td>
<td>16</td>
<td>10%</td>
</tr>
<tr>
<td>Recherche sur Internet</td>
<td>10</td>
<td>6%</td>
</tr>
</tbody>
</table>

La figure ci-dessous montre le type d’emploi des nouveaux diplômés au sein de la profession vétérinaire. La plupart des diplômés sont employés dans une pratique clinique/privée et 52 % des nouveaux diplômés sont satisfaits de leur emploi actuel.

Figure 4. Type d’emploi actuel des nouveaux diplômés de la profession vétérinaire (n = 148).

| Gouvernement                          | 56               | 39%|
| Industrie/commerce                   | 44               | 30%|
| Autre                                | 41               | 28%|
| Internat/résidence                   | 8                | 6% |
| Pratique clinique/privee             | 47               | 32%|

La figure ci-après indique combien de temps les répondants consacrent aux diverses espèces animales. Par rapport à l’année dernière, les diplômés passent plus de temps à traiter des animaux de compagnie, moins de temps à soigner des chevaux et des bovins, et plus de temps à pratiquer la médecine porcine.
Figure 5. Average amount of time graduates spent treating various animal species ($n = 140$).

<table>
<thead>
<tr>
<th>Species</th>
<th>Ave. % of time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canine</td>
<td>48%</td>
</tr>
<tr>
<td>Feline</td>
<td>38.5%</td>
</tr>
<tr>
<td>Equine</td>
<td>12.5%</td>
</tr>
<tr>
<td>Bovine — beef</td>
<td>4%</td>
</tr>
<tr>
<td>Bovine — dairy</td>
<td>6%</td>
</tr>
<tr>
<td>Other</td>
<td>18%</td>
</tr>
<tr>
<td>Porcine</td>
<td>2%</td>
</tr>
<tr>
<td>Caged pets and birds</td>
<td>2%</td>
</tr>
<tr>
<td>Small ruminants</td>
<td>1.5%</td>
</tr>
<tr>
<td>Poultry</td>
<td>0.5%</td>
</tr>
<tr>
<td>Bovine — veal</td>
<td>0.5%</td>
</tr>
<tr>
<td>Farmed game</td>
<td>0%</td>
</tr>
<tr>
<td>No contact with species</td>
<td>0%</td>
</tr>
</tbody>
</table>

Income and compensation data

Respondents ($n = 117$) indicated their average annual base salary practicing in Canada is $73 241 and included “Other” employment categories such as consultant, shelter medicine and a university. The average annual base salary for graduates currently employed in residency or part of an internship is $32 857. The average annual base salary for graduates practicing internationally is $36 056.

Figure 6. Province/Territory of employment and average annual base salary ($n = 121$).

<table>
<thead>
<tr>
<th>Province/Territory</th>
<th># of respondents</th>
<th>Ave. base salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alberta</td>
<td>24</td>
<td>$79 348</td>
</tr>
<tr>
<td>British Columbia</td>
<td>20</td>
<td>$82 057</td>
</tr>
<tr>
<td>Manitoba</td>
<td>8</td>
<td>$73 875</td>
</tr>
<tr>
<td>New Brunswick</td>
<td>3</td>
<td>$72 167</td>
</tr>
<tr>
<td>Newfoundland and Labrador</td>
<td>3</td>
<td>$82 333</td>
</tr>
<tr>
<td>Northwest Territories</td>
<td>0</td>
<td>N/A</td>
</tr>
<tr>
<td>Nova Scotia</td>
<td>5</td>
<td>$68 500</td>
</tr>
<tr>
<td>Nunavut</td>
<td>0</td>
<td>N/A</td>
</tr>
<tr>
<td>Ontario</td>
<td>28</td>
<td>$85 525</td>
</tr>
<tr>
<td>Prince Edward Island</td>
<td>3</td>
<td>$71 000</td>
</tr>
<tr>
<td>Quebec</td>
<td>13</td>
<td>$77 100</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>14</td>
<td>$73 333</td>
</tr>
<tr>
<td>Yukon</td>
<td>0</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Données sur le revenu et la rémunération

Les répondants ($n = 117$) exerçant au Canada ont indiqué que leur salaire de base annuel moyen était de 73 241 $, et certains ont indiqué « Autre » comme type d’emploi (consultation, médecine de refuge et travail en milieu universitaire). Le salaire de base annuel moyen des diplômés en cours d’internat ou de résidence était de 32 857 $. Le salaire de base annuel moyen des diplômés exerçant à l’étranger était de 36 056 $.

Figure 6. Province/territoire d’emploi et salaire de base annuel moyen ($n = 121$).

<table>
<thead>
<tr>
<th>Province/territoire</th>
<th>Nombre de répondants</th>
<th>Salaire de base moyen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alberta</td>
<td>24</td>
<td>79 348 $</td>
</tr>
<tr>
<td>Colombie-Britannique</td>
<td>20</td>
<td>82 057 $</td>
</tr>
<tr>
<td>Manitoba</td>
<td>8</td>
<td>73 875 $</td>
</tr>
<tr>
<td>Nouveau-Brunswick</td>
<td>3</td>
<td>72 167 $</td>
</tr>
<tr>
<td>Terre-Neuve-et-Labrador</td>
<td>3</td>
<td>82 333 $</td>
</tr>
<tr>
<td>Territoires du Nord-Ouest</td>
<td>0</td>
<td>N. d.</td>
</tr>
<tr>
<td>Nouvelle-Écosse</td>
<td>5</td>
<td>68 500 $</td>
</tr>
<tr>
<td>Nunavut</td>
<td>0</td>
<td>N. d.</td>
</tr>
<tr>
<td>Ontario</td>
<td>28</td>
<td>85 525 $</td>
</tr>
<tr>
<td>Île-du-Prince-Édouard</td>
<td>3</td>
<td>71 000 $</td>
</tr>
<tr>
<td>Québec</td>
<td>13</td>
<td>77 100 $</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>14</td>
<td>73 333 $</td>
</tr>
<tr>
<td>Yukon</td>
<td>0</td>
<td>N. d.</td>
</tr>
</tbody>
</table>
Out of 142 respondents, 92% of new graduates are following the same career path they intended \( (n = 130) \). Reasons a graduate decided not to continue in veterinary medicine included a lack of positions available in their desired location of practice, changes in their personal life, and changes in interest during study.

New graduate veterinarians work an average of 40 hours per week \( (n = 117) \). The results also show they work with 3.6 full-time veterinarians and 1.6 part-time veterinarians, though answers were quite variable.

**Figure 7.** Average school-related debt (in Cdn $) upon graduation sorted by school over the last 3 years \( (n = 114) \).

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2018</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVC</td>
<td>$143 353</td>
<td>$116 917</td>
<td>$100 625</td>
</tr>
<tr>
<td></td>
<td>( (n = 17) )</td>
<td>( (n = 12) )</td>
<td>( (n = 8) )</td>
</tr>
<tr>
<td>FMV</td>
<td>$22 333</td>
<td>$23 636</td>
<td>$36 568</td>
</tr>
<tr>
<td></td>
<td>( (n = 3) )</td>
<td>( (n = 22) )</td>
<td>( (n = 28) )</td>
</tr>
<tr>
<td>OVC</td>
<td>$73 469</td>
<td>$49 500</td>
<td>$51 967</td>
</tr>
<tr>
<td></td>
<td>( (n = 32) )</td>
<td>( (n = 23) )</td>
<td>( (n = 20) )</td>
</tr>
<tr>
<td>UCVM</td>
<td>$41 611</td>
<td>$53 000</td>
<td>$59 077</td>
</tr>
<tr>
<td></td>
<td>( (n = 11) )</td>
<td>( (n = 10) )</td>
<td>( (n = 13) )</td>
</tr>
<tr>
<td>WCVM</td>
<td>$56 904</td>
<td>$49 690</td>
<td>$60 914</td>
</tr>
<tr>
<td></td>
<td>( (n = 51) )</td>
<td>( (n = 29) )</td>
<td>( (n = 35) )</td>
</tr>
</tbody>
</table>

**Figure 8.** Method of compensation received by respondents \( (n = 137) \).

- **Straight salary**
- **Base salary plus % of gross earnings or billings**
- **Income based on % of gross earnings or billings**
Figure 9. Avantages professionnels dont profitent les nouveaux diplômés en plus de leur salaire de base. Les répondants pouvaient cocher plus d’une réponse ($n = 134$).

<table>
<thead>
<tr>
<th>Avantage professionnel</th>
<th>Nombre de répondants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primes après les heures d'ouverture ou pour les gardes</td>
<td>51</td>
</tr>
<tr>
<td>Téléphone cellulaire</td>
<td>34</td>
</tr>
<tr>
<td>Indemnité d'habillement</td>
<td>52</td>
</tr>
<tr>
<td>Frais d'inscription à des activités de formation continue</td>
<td>114</td>
</tr>
<tr>
<td>Frais de déplacement pour la formation continue</td>
<td>69</td>
</tr>
<tr>
<td>Assurance invalidité</td>
<td>49</td>
</tr>
<tr>
<td>Assurance dentaire</td>
<td>81</td>
</tr>
<tr>
<td>Assurance maladie</td>
<td>97</td>
</tr>
<tr>
<td>Assurance vie</td>
<td>39</td>
</tr>
<tr>
<td>Assurance responsabilité professionnelle</td>
<td>86</td>
</tr>
<tr>
<td>Paiement des frais de cotisation pour le renouvellement du permis d'exercice</td>
<td>113</td>
</tr>
<tr>
<td>Paiement des frais d'adhésion volontaire à une association professionnelle (AAHA, ACMV, OVMA, AMVQ, etc.)</td>
<td>61</td>
</tr>
<tr>
<td>Régime de retraite</td>
<td>10</td>
</tr>
<tr>
<td>Part des profits</td>
<td>7</td>
</tr>
<tr>
<td>Prime de rétention</td>
<td>1</td>
</tr>
<tr>
<td>Indemnité pour véhicule ou frais de transport</td>
<td>24</td>
</tr>
<tr>
<td>Autre (veuillez préciser)</td>
<td>13</td>
</tr>
</tbody>
</table>

Divers
De plus, on a demandé aux répondants s'ils étaient membres d'autres organisations professionnelles.

Other
Graduates were asked about their toughest challenges as a new graduate; responses ranged from mental health issues to trouble finding employment to trouble practically applying theoretical knowledge. However, a few trends stood out that are listed in order of decreasing prevalence:
1. Clients and communication
2. Self-doubt and a lack of confidence
3. Time management and work-life balance
4. Poor mentorship
5. Finances.

Additionally, respondents were asked if they are currently a member of a variety of professional organizations and affiliations that can be seen below.

<table>
<thead>
<tr>
<th>Professional benefit</th>
<th># of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>After hours/on-call premiums</td>
<td>51</td>
</tr>
<tr>
<td>Cellphone</td>
<td>34</td>
</tr>
<tr>
<td>Clothing allowance</td>
<td>52</td>
</tr>
<tr>
<td>Continuing education fees</td>
<td>114</td>
</tr>
<tr>
<td>Continuing education travel expenses</td>
<td>69</td>
</tr>
<tr>
<td>Disability insurance</td>
<td>49</td>
</tr>
<tr>
<td>Dental insurance</td>
<td>81</td>
</tr>
<tr>
<td>Health insurance</td>
<td>97</td>
</tr>
<tr>
<td>Life insurance</td>
<td>39</td>
</tr>
<tr>
<td>Malpractice insurance</td>
<td>86</td>
</tr>
<tr>
<td>Payment of licensing fees</td>
<td>113</td>
</tr>
<tr>
<td>Payment of fees for voluntary professional association membership (e.g. AAHA, CVMA, OVMA, AMVQ)</td>
<td>61</td>
</tr>
<tr>
<td>Pension</td>
<td>10</td>
</tr>
<tr>
<td>Profit sharing</td>
<td>7</td>
</tr>
<tr>
<td>Retention</td>
<td>1</td>
</tr>
<tr>
<td>Sick leave/compassionate leave</td>
<td>52</td>
</tr>
<tr>
<td>Vehicle allowance/transportation expenses</td>
<td>24</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>13</td>
</tr>
</tbody>
</table>
Figure 10. Professional organizations and affiliations listed by respondents ($n = 119$). Respondents had the option of checking more than one.

<table>
<thead>
<tr>
<th>Organization</th>
<th># of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Animal Hospital Association (AAHA)</td>
<td>4</td>
</tr>
<tr>
<td>Association des médecins vétérinaires du Québec (AMVQ) en pratique des petits animaux</td>
<td>0</td>
</tr>
<tr>
<td>Canadian Veterinary Medical Association (CVMA)</td>
<td>119</td>
</tr>
<tr>
<td>I am not a member of another professional organization</td>
<td>10</td>
</tr>
<tr>
<td>Other</td>
<td>28</td>
</tr>
</tbody>
</table>

Other organizations:
- Alberta Veterinary Medical Association (ABVMA)
- American Association of Bovine Practitioners (AABP)
- American Association of Equine Practitioners (AAEP)
- American Association of Feline Practitioners (AAFP)
- American Association for Laboratory Animal Science (AALAS)
- American Association of Swine Veterinarians (AASV)
- American College of Veterinary Pathologists (ACVP)
- American Veterinary Medical Association (AVMA)
- Arizona Association of Veterinary Medicine (AzVMA)
- Association of Veterinary Acupuncturists of Canada (AVAC)
- British Veterinary Association (BVA)
- Canadian Academy of Veterinary Dermatology (CAVD)
- Canadian Association for Laboratory Medicine (CALAM)
- Canadian Association of Swine Veterinarians (CASV/ACMAL)
- Canadian Embryo Transfer Association (CETA/ACTE)
- Edmonton Association of Small Animal Veterinarians (EASAV)
- International Veterinary Acupuncture Society (IVAS)
- Royal College of Veterinary Surgeons (RCVS)
- Ontario Association of Bovine Practitioners (OABP)
- The Society of Toxicologic Pathology (STP)
- Western Canadian Association of Swine Veterinarians (WCASV)

On behalf of the Students of the Canadian Veterinary Medical Association, I would like to thank those of the graduating Class of 2019 who took the time to respond to our Annual Graduate Survey!

(by Rachel Loppe, B. Sc., University of Calgary Faculty of Veterinary Medicine, Class of 2021)

---

Figure 10. Organisations professionnelles et affiliations répertoriées par les répondants. Les répondants pouvaient cocher plus d’une réponse ($n = 119$).

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Nombre de répondants</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Animal Hospital Association (AAHA)</td>
<td>4</td>
</tr>
<tr>
<td>Association des médecins vétérinaires du Québec (AMVQ) en pratique des petits animaux</td>
<td>0</td>
</tr>
<tr>
<td>Association canadienne des médecins vétérinaires (ACMV)</td>
<td>119</td>
</tr>
<tr>
<td>Je ne suis pas membre d’une autre organisation professionnelle</td>
<td>10</td>
</tr>
<tr>
<td>Autre</td>
<td>28</td>
</tr>
</tbody>
</table>

Autres organisations :
- Alberta Veterinary Medical Association (ABVMA)
- American Association of Bovine Practitioners (AABP)
- American Association of Equine Practitioners (AAEP)
- American Association of Feline Practitioners (AAFP)
- American Association for Laboratory Animal Science (AALAS)
- American Association of Swine Veterinarians (AASV)
- American College of Veterinary Pathologists (ACVP)
- American Veterinary Medical Association (AVMA)
- Arizona Association of Veterinary Medicine (AzVMA)
- Association des vétérinaires acupuncteurs du Canada (AVAC)
- British Veterinary Association (BVA)
- Académie canadienne de dermatologie vétérinaire (CAVD)
- Association canadienne de la médecine des animaux de laboratoire (ACMAL)
- Association canadienne des vétérinaires porcins (CASV/ACMAL)
- Association canadienne de transfert d’embryons (CETA/ACTE)
- Edmonton Association of Small Animal Veterinarians (EASAV)
- International Veterinary Acupuncture Society (IVAS)
- Royal College of Veterinary Surgeons (RCVS)
- Ontario Association of Bovine Practitioners (OABP)
- The Society of Toxicologic Pathology (STP)
- Western Canadian Association of Swine Veterinarians (WCASV)

Au nom du comité des étudiants de l’Association canadienne des médecins vétérinaires, je tiens à remercier les diplômés de la promotion de 2019 qui ont pris le temps de répondre à notre sondage annuel!

(par Rachel Loppe, B. Sc., University of Calgary Faculty of Veterinary Medicine, promotion de 2021)
Exciting! Inspiring! Motivating!
2020 CVMA Convention
July 9 to 12

The CVMA Convention is less than 4 months away! Spring into action if you have not already registered and you can take advantage of the early bird savings up until April 30th for the Convention. The Convention offers over 130 hours of Continuing Education (CE), which means you can earn up to 27 credits. Top-notch speakers from Canada and the United States have been invited to make presentations.

Dr. Alexander Reiter, a diplomate of the American Veterinary Dental College (AVDC) and European Veterinary Dental College (EVDC) and professor and chief of Dentistry and Oral Surgery at the University of Pennsylvania's small animal hospital, will present 5 lectures on companion animal dentistry on Friday, July 10. Dr. Reiter will review Oral Inflammation in Cats; Techniques of Tooth Extraction; Jaw Fractures and Oral Soft Tissue Trauma; Staging and Treatments of Oral Tumors; and will present Examples of Oral and Maxillofacial Reconstruction.

Dr. Patricia Turner, a laboratory animal veterinarian and pathologist who works as corporate vice-president, Global Animal Welfare for Charles River Laboratories, will present 6 lectures on Animal Welfare — Bioethical Challenges on Saturday, July 11. Dr. Turner will review Applied Veterinary Bioethics; Veterinary Bioethics and Moral Distress in Veterinary Practice; Bioethical Challenges — Medically Unnecessary Surgeries; Bioethical Challenges — Selective Animal Breeding; Veterinary Bioethics; and Food Animal Practice. Dr. Turner will also be discussing Veterinary Bioethics — End of Life Decision-Making and Euthanasia.

Dr. Cherie Buisson, an owner of A Happy Vet and Helping Hands Pet Hospice in Largo, Florida, will present 3 lectures on Professional Wellness — Euthanasia and Palliative Medicine on Sunday, July 12 as well as 3 lectures on Professional Satisfaction. Dr. Buisson will share her experience with Getting Comfortable with Hospice and Palliative Medicine; and How to Be Happy in Veterinary Medicine.

For more information on the speakers mentioned above, and session information, be sure to visit the new convention microsite (https://pheedloop.com/cvma20/site/home/) or download the CVMA Convention App (https://pheedloop.com/cvma20/).

See you in Quebec City!

(by Sarah Cunningham, Manager, Conventions, CVMA)
It’s Time to Applaud this Country’s Volunteers
National Volunteer Week
April 19 to 25, 2020

National Volunteer Week is an ideal opportunity to honor the veterinarians, veterinary technicians/technologists, students, and other volunteers who donate their time and expertise to the Canadian Veterinary Medical Association’s (CVMA’s) various projects in support of Canada’s veterinary profession.

This year’s National Volunteer Week theme, “It’s time to applaud this country’s volunteers,” is truly fitting given the extraordinary way our volunteers contribute to the CVMA and the veterinary community. The time and effort volunteers dedicate to the Association is immeasurable and the individuals are invaluable. The CVMA owes its many years of success to the thousands of volunteers who have assisted us. We depend on the contributions of our devoted volunteers across Canada to help the Association achieve a variety of goals and objectives and ensure the voice of the Canadian veterinary profession is heard across the country and around the world. We are indebted to them for their service.

Over 600 volunteers support the work of the Association, through their work on the Executive, Council, various standing committees, advisory groups, and task forces, and by reviewing articles for the CVMA journals. CVMA’s volunteers take time from their demanding schedules to act as ambassadors in media interviews and represent the CVMA and the veterinary profession on 27 different external boards, associations, legislative and policy-making groups, both in Canada and abroad.

The CVMA’s achievements are due to the devotion of our many volunteers. We sincerely thank you for donating your time and expertise.

Il est temps d’applaudir les bénévoles de ce pays – Semaine nationale de l’action bénévole du 19 au 25 avril 2020

La Semaine nationale de l’action bénévole est une excellente occasion d’honorer les médecins vétérinaires, les techniciens en santé animale, les étudiants et toutes les autres personnes qui offrent leur temps et leur expertise pour aider l’Association canadienne des médecins vétérinaires (ACMV) à concrétiser divers projets soutenant la profession vétérinaire au Canada.

Le thème de la Semaine nationale de l’action bénévole de cette année, « Il est temps d’applaudir les bénévoles de ce pays », est tout à fait approprié étant donné la façon extraordinaire dont nos bénévoles contribuent à l’ACMV et à la communauté vétérinaire. Nos bénévoles sont inestimables et le temps et les efforts qu’ils consacrent à l’Association sont incommensurables. L’ACMV doit ses nombreuses années de succès aux milliers de bénévoles qui nous ont offert leur aide. Nous comptons sur l’apport de nos bénévoles dévoués d’un océan à l’autre pour atteindre nos objectifs et faire en sorte que la voix de la profession vétérinaire canadienne soit entendue partout au pays et dans le monde. Nous leur devons beaucoup.

Plus de 600 bénévoles soutiennent le travail de l’Association, par leur implication au sein du Comité exécutif, du Conseil, des divers comités permanents et des groupes de consultation et de travail, ou encore par la révision des articles pour les publications de l’ACMV. Nos bénévoles prennent du temps malgré leurs horaires exigeants pour agir comme ambassadeurs dans les entrevues avec les médias et représenter l’ACMV et la profession vétérinaire au sein de 27 comités, conseils, associations ou groupes d’élaboration de lois et de politiques externes, tant au Canada qu’à l’étranger.

Les réalisations de l’ACMV sont dues au dévouement de nos nombreux bénévoles. Nous vous remercions sincèrement de nous offrir si généreusement votre temps et votre expertise.
Obituary
AVC Founding Faculty Member Dr. Bob Curtis Passes Away

The Atlantic Veterinary College (AVC) at the University of Prince Edward Island is saddened by the loss of a founding faculty member, Dr. Bob Curtis, who passed away on December 8.

Born in Orangeville, Ontario, in 1931, Dr. Curtis came from an agricultural background. He worked on his home farm during his early schooling and went on to operate his own beef farm. In 1956 he entered the Doctor of Veterinary Medicine program at the Ontario Veterinary College, graduating first in his class in 1961. Subsequently, he was appointed to the College’s Department of Clinical Studies and Ambulatory Clinic. After receiving his Master of Science degree in 1968, he was promoted to associate professor and in 1975 to full professor.

In 1985 Dr. Curtis joined the new Atlantic Veterinary College at UPEI as the inaugural chair of the Department of Health Management. He brought to the College high standards in teaching, applied research, and professional service, along with a prolific scholarly publishing record. He laid the groundwork for a department that is highly regarded for its award-winning faculty and outstanding competence in animal care and veterinary medicine.

Dr. Curtis also played a critical role in the planning and development of AVC’s Veterinary Teaching Hospital. As co-director during the early years, he was invaluable in setting up the hospital and establishing a client base and teaching caseload.

He was renowned for his love of service to clients and for his dedication to the students he taught. He established 2 student awards — the Dr. R.A. Curtis Bovine Award for a graduating student finishing 1st in the class in bovine medicine, and the Dr. R.A. Curtis Bovine Externship Award for 3rd-year students interested in bovine practice and willing to engage in an external elective outside of Atlantic Canada.

A leader in the veterinary profession in Canada, Dr. Curtis was recognized by his peers for his contributions with a Life Membership in the Canadian Veterinary Medical Association, the Ontario Veterinary College Distinguished Alumnus Award in 1988, and the CVMA Schering Award in 1986.

Dr. Curtis retired from AVC in September 1996. In 2009, the College presented him with its highest honor, the Honorable Eugene F. Whelan Green Hat Award, for his contributions to its establishment and success.

Dr. Greg Keefe, dean of AVC, remembers Dr. Curtis as a good friend.

“While Dr. Curtis retired in 1996, he remained a very regular visitor to the college. Our time together as faculty members only overlapped for a short period, but post-retirement he regularly provided insights to me throughout my career. He became a very good friend to both Debbie and me. We will miss him dearly.”

Nécrologie
Décès du Dr Bob Curtis, membre du corps professoral fondateur de l’AVC

Le personnel de l’Atlantic Veterinary College (AVC) de l’Université de l’Île-du-Prince-Édouard est attristé par la perte d’un de ses membres des premiers jours, le Dr Bob Curtis, décédé le 8 décembre.


En 1985, le Dr Curtis s’est joint au nouvel Atlantic Veterinary College de l’UPEI en tant que premier directeur du département de régie de la santé. Il a su établir à l’AVC des normes élevées en matière d’enseignement, de recherche appliquée et de service professionnel, et a fait rayonner l’AVC grâce à son dossier de publication prolifique. Il a jeté les bases d’un département réputé pour son corps professoral primé et ses compétences exceptionnelles en soins des animaux et en médecine vétérinaire.

Le Dr Curtis a également joué un rôle essentiel dans la conception et le développement de l’hôpital vétérinaire d’enseignement de l’AVC. En tant que codirecteur au cours des premières années, il a été inestimable pour la mise en place de l’hôpital, l’établissement d’une clientèle et l’obtention de cas pour l’enseignement.

Il était réputé pour son amour du service à la clientèle et pour son dévouement envers les étudiants auxquels il enseignait. Il a créé deux prix décernés aux étudiants : le prix « Dr. R.A. Curtis Bovine Award » remis à l’étudiant de dernière année terminant premier de sa classe en médecine bovine et le prix « Dr. R.A. Curtis Bovine Externship Award » destiné aux étudiants de troisième année intéressés par la pratique bovine et désireux de faire un stage à l’extérieur du Canada atlantique.

À titre de leader au sein de la profession vétérinaire au Canada, le Dr Curtis a été reconnu par ses pairs en étant nommé membre à vie de l’Association canadienne des médecins vétérinaires (ACMV), en plus de recevoir le prix « OVC Distinguished Alumnus Award » en 1988 et le prix Schering de l’ACMV en 1986.


Le Dr Greg Keefe, doyen de l’AVC, se souvient du Dr Curtis comme d’un bon ami.

« Même s’il a pris sa retraite en 1996, le Dr Curtis continuait de venir à l’AVC très souvent. Nous avons été collègues seulement pendant une courte période, mais après sa retraite, il m’a régulièrement conseillé tout au long de ma carrière. Il est devenu un de nos très bons amis, à Debbie et à moi. Il nous manquera terriblement. »
Non–invasive blood pressure measurement in animals: Part 1 — Techniques for measurement and validation of non-invasive devices
Alicia Skelding, Alexander Valverde

Abstract — Arterial blood pressure is a common parameter evaluated in conscious and anesthetized veterinary species. Non-invasive blood pressure measurement techniques, such as Doppler ultrasonic flow detector and oscillometry, are attractive in certain animals due to their availability and ease of use. The greatest limitation to non-invasive blood pressure monitoring can be its inaccuracy, particularly in hypotensive or hypertensive patients and in certain species. Part 1 of this 2-part review summarizes the current techniques available to non-invasively measure arterial blood pressure in animals and discusses validation of non-invasive devices. Part 2 summarizes the veterinary literature that evaluates the use of non-invasive blood pressure measurement techniques in conscious and anesthetized species and develops general conclusions for proper use and interpretation of data from non-invasive blood pressure devices.

Rédsumé — Mesures de la pression sanguine chez les animaux de manière non-invasive : Partie 1 – Techniques pour mesurer et validation d’appareils non-invasifs. La pression sanguine artérielle est un paramètre fréquemment évalué chez les espèces animales conscientes et anesthésiées. Des techniques non-invasives de mesure de la pression sanguine, telles que le détecteur ultra-sonique de flot Doppler et l’oscillométrie, sont attirantes chez certains animaux étant donné leur disponibilité et facilité d’utilisation. La plus grande limitation au suivi non-invasif de la pression sanguine peut être son imprécision, particulièrement chez les patients hypotensifs ou hypertensifs et chez certaines espèces. La partie 1 de cette revue en deux parties résume les techniques présemment disponibles pour mesurer de manière non-invasive la pression sanguine artérielle chez des animaux et discute la validation d’équipements non-invasifs. La partie 2 résume la littérature vétérinaire qui évalue l’utilisation de techniques de mesure non-invasives de la pression sanguine chez des espèces conscientes et anesthésiées et développe des conclusions générales pour l’utilisation appropriée et l’interprétation des données obtenues d’équipements non-invasifs de mesure de la pression sanguine.

(Traduit par D’ Serge Messier)
Arterial BP values can vary depending on the anatomic site from which they are measured, which has important considerations when evaluating NIBP measurement devices. Systolic arterial BP increases towards the periphery as a result of reflection of pressure waves from smaller arterioles due to a stronger muscular wall and higher resistance, whereas diastolic arterial BP decreases slightly, and mean arterial BP stays fairly constant (4). In anesthetized dogs, the systolic arterial BP from the dorsal pedal artery and femoral artery is higher than from the carotid artery (5), but variations in arterial pressure in smaller peripheral arteries also occur. For example, during normotension, the systolic arterial BP in anesthetized dogs is higher in the dorsal pedal artery than in the lingual artery (6) and in anesthetized horses, the systolic arterial BP tends to be higher in the metatarsal artery than in the facial artery and the transverse facial artery (7). The difference between systolic and diastolic arterial pressures is the pulse pressure. As a result of the increase in systolic arterial BP, the pulse pressure also increases from the aorta to the periphery. In humans this difference is, on average, 15 mmHg (8).

Mean arterial BP (MABP) is the product of cardiac output (CO) and total systemic vascular resistance (SVR); therefore, it is directly affected by these 2 factors.

\[
\text{MABP} = \text{CO} \times \text{SVR} \quad \text{Equation 1}
\]

This equation shows that alterations in vascular resistance could result in similar changes in mean arterial BP; even if cardiac output remains unchanged blood flow to tissues could be compromised. Clinically, mean arterial BP is more readily measured than CO, but when monitoring arterial BP it is important to take into consideration how changes in CO and SVR can impact the measured arterial BP value. Studies in anesthetized animals have shown that poor correlation exists between CO and arterial BP (9–11). This poor correlation is even more apparent with the administration of drugs that increase SVR, especially if contractility is impaired or hypovolemia is present. Conversely, arterial BP values can be lower than normal values due to a decrease in SVR, as commonly occurs with the use of inhalational anesthetics or phenothiazines due to their vasodilatory properties. Cardiac output can still be within acceptable values because the decrease in afterload eases cardiac work (12) (Table 1).

Tissue demand for oxygen \([\text{O}_2]\) normally determines the amount of blood flow (CO) reaching the tissues; therefore, \(\text{VO}_2\) is the independent factor. The relationship between CO and \(\text{VO}_2\) is linear under physiological conditions, such as during periods of exercise in which enhanced tissue blood flow is required to satisfy the increased \(\text{VO}_2\). During general anesthesia with inhalational anesthetics at doses up to 2× the minimum alveolar concentration, there is a decrease in CO but also a decrease in \(\text{VO}_2\), such that tissue demand for oxygen remains fulfilled (13).

An appropriate value for mean arterial BP does not necessarily reflect adequate blood flow to peripheral tissues. Despite this, an association has been established in non-cardiac human patients between mean arterial BP values of < 55 mmHg, recorded during surgery, and the risk of developing acute kidney injury or myocardial injury after surgery (14). In contrast, septic human patients in an intensive care unit receiving titrated norepinephrine did not show any improvement in skin microcirculatory blood flow, urine output, or splanchic perfusion, when the mean arterial BP was increased from 65 to 85 mmHg (15). These findings emphasize the importance of proper interpretation of arterial BP values, consideration of all factors that influence arterial BP as discussed, the age or health status of the patient, whether the patient is conscious, sedated, or anesthetized, and the pharmacological effects of drugs used prior to BP measurements. It has been shown that arterial BP values differ between conscious and anesthetized states as well as across veterinary species (Table 2), which is another important consideration when interpreting arterial BP values.

**Validation of noninvasive blood pressure devices**

In order for an NIBP measurement device to be considered a “validated device,” it must meet specific criteria to demonstrate that it is an acceptable alternative to a “gold standard” measurement technique. In human medicine, NIBP devices may

### Table 1. Reported direct arterial blood pressure (mmHg) and cardiac index (mL/kg BW per minute) values in conscious and anesthetized [1.0 to 1.25 and 1.75 to 2.0 minimum alveolar concentration (MAC)] of sevoflurane in dogs and cats. Values reported as mean ± SD.

<table>
<thead>
<tr>
<th>Species</th>
<th>Systolic</th>
<th>Mean</th>
<th>Diastolic</th>
<th>Cardiac index</th>
<th>Inhalant</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dogs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conscious</td>
<td>134 ± 17</td>
<td>96 ± 17</td>
<td>73 ± 7</td>
<td>95 ± 16</td>
<td>NA</td>
<td>(42)</td>
</tr>
<tr>
<td>1.0–1.25 MAC</td>
<td>104 ± 17</td>
<td>75 ± 10</td>
<td>60 ± 10</td>
<td>105 ± 32</td>
<td>Sevoflurane</td>
<td>(42)</td>
</tr>
<tr>
<td>1.75–2.0 MAC</td>
<td>79 ± 13</td>
<td>59 ± 10</td>
<td>46 ± 10</td>
<td>80 ± 32</td>
<td>Sevoflurane</td>
<td>(42)</td>
</tr>
<tr>
<td>Cats</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conscious</td>
<td>126 ± 9</td>
<td>106 ± 10</td>
<td>91 ± 11</td>
<td>NA</td>
<td>NA</td>
<td>(43)</td>
</tr>
<tr>
<td>1.0 to 1.25 MAC</td>
<td>131 ± 8</td>
<td>113 ± 7</td>
<td>94 ± 7</td>
<td>NA</td>
<td>NA</td>
<td>(44)</td>
</tr>
<tr>
<td>1.75 to 2.0 MAC</td>
<td>136 ± 13</td>
<td>117 ± 12</td>
<td>101 ± 9</td>
<td>188 ± 64</td>
<td>NA</td>
<td>(45)</td>
</tr>
</tbody>
</table>

BW — body weight; NA — not applicable.
be validated for accuracy using 1 of 3 outlined methods: the Association for the Advancement of Medical Instrumentation (AAMI) in the United States, adopted by the International Standards Organization (AAMI-ISO) in 2007, revised in 2013; the British Hypertension Society (BHS), revised in 1993; or the European Society of Hypertension International Protocol (ESH-IP), revised in 2010 (16). The ESH-IP protocol is an updated version of the BHS protocol, with more refined parameters and more stringent criteria to reflect advancements in technology, and it is the most widely used validation protocol for NIBP devices (16). Recently, these organizations came together to develop an internationally recognized and universally accepted standard protocol for the validation of BP measuring devices in human patients. The collaboration statement outlines 9 key aspects to the validation process, such as the minimum sample size for a validation study, BP cuff location and minimum number of patients assessed per cuff size and width variation, recommendations for general population versus special population studies, reference method (auscultatory) and required reporting in published studies (17). As a follow-up to this statement, a fully developed standard is set to be published soon (17).

In human studies, the reference method for validation of the NIBP device in question is the auscultatory technique, which utilizes a mercury sphygmomanometer and stethoscope to auscultate the Korotkoff sounds to detect systolic and diastolic arterial BP. In regard to passing criteria for the device to be validated, the ESH-IP requires the following criteria to be fulfilled: i) that 2 of the following are met, 74% (73/99) measurement errors to be within 5 mmHg, at least 88% (87/99) to be within 10 mmHg and at least 97% (96/99) to be within 15 mmHg of the auscultatory method values; and ii) that all of the following are met, 66% (65/99) measurement errors to be within 5 mmHg, at least 82% (81/99) to be within 10 mmHg and at least 96% (95/99) to be within 15 mmHg of the auscultatory method values (16).

In veterinary medicine, consensus validation standards have not been established, but there are recommendations from the American College of Veterinary Internal Medicine (ACVIM) Hypertension Consensus Panel and the Veterinary Blood Pressure Society Recommendations (AHCP-VBPS Validation) (18). In those assessments, it was recognized that none of the devices used in dogs and cats meet the criteria of human protocols. They recommended that the tested indirect device be compared to a direct, intra-arterial BP measurement, or to an indirect device for which validation has been previously published in a refereed journal (18). Interestingly, the BHS protocol for validation of devices in human medicine did not recommend comparison of indirect methods to direct intra-arterial BP since systolic and diastolic arterial BP values obtained by the direct technique are different from measurements obtained by indirect methods. This is due to considerable beat-to-beat variation in BP, which is not reflected in indirect readings. Blood pressure simultaneously measured directly and indirectly from the same artery can have random discrepancies in systolic arterial BP as great as 24 mmHg for systolic and 16 mmHg for diastolic arterial BP (19). An updated consensus statement on the diagnosis and management of systemic hypertension in dogs and cats has been published by the ACVIM; however, no adjustments have been made to the recommended validation criteria for NIBP measurement devices (20).

The AHCP-VBPS Validation also recommends that findings of any validated device should be applied only to the species and conditions in which the study was conducted, and this includes anesthetized versus conscious patients. The passing criteria recommended by this panel includes that the mean error must be at most 10 ± 15 mmHg (mean ± SD) for systolic and diastolic arterial BP with a correlation of ≥ 0.9, that 50% of all BP measurements lie within 10 mmHg of the reference method; that 80% of all measurements lie within 20 mmHg of the reference method; that the results are published in a refereed journal; and that the database contain at least 8 individuals for comparison with an intra-arterial method, or 25 animals for comparison with a previously validated indirect device (18). The criteria do not specifically mention requirements for measurements of mean arterial BP, but it can be assumed that

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**Table 2.** Reported direct arterial blood pressure (mmHg) values in normal, awake veterinary species. Values reported as mean ± SD.  

<table>
<thead>
<tr>
<th>Species</th>
<th>Systolic</th>
<th>Mean</th>
<th>Diastolic</th>
<th>Catheter site (artery)</th>
<th>N</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dogs</td>
<td>154 ± 20</td>
<td>107 ± 11</td>
<td>84 ± 9</td>
<td>Femoral</td>
<td>27</td>
<td>(47)</td>
</tr>
<tr>
<td></td>
<td>134 ± 17</td>
<td>96 ± 17</td>
<td>73 ± 7</td>
<td>Aorta</td>
<td>11</td>
<td>(42)</td>
</tr>
<tr>
<td>Cats</td>
<td>126 ± 9</td>
<td>106 ± 10</td>
<td>91 ± 11</td>
<td>Femoral</td>
<td>6</td>
<td>(43)</td>
</tr>
<tr>
<td></td>
<td>130.9 ± 8.2</td>
<td>113.2 ± 7.2</td>
<td>94.4 ± 6.9</td>
<td>Carotid</td>
<td>17</td>
<td>(44)</td>
</tr>
<tr>
<td>Horses</td>
<td>169 ± 24.6</td>
<td>131.5 ± 18</td>
<td>110.4 ± 16.3</td>
<td>Coccygeal artery</td>
<td>8</td>
<td>(48)</td>
</tr>
<tr>
<td>Cattle</td>
<td>159.7 ± 11.3</td>
<td>127 ± 6.2</td>
<td>96.7 ± 8.6</td>
<td>Auricular</td>
<td>6</td>
<td>(49)</td>
</tr>
<tr>
<td>Elephants</td>
<td>178.6 ± 2.94</td>
<td>144.6 ± 2.90</td>
<td>118.7 ± 3.10</td>
<td>Auricular</td>
<td>15</td>
<td>(50)</td>
</tr>
<tr>
<td>Rabbits</td>
<td>68</td>
<td>57 ± 8.2</td>
<td>48</td>
<td>Auricular</td>
<td>14</td>
<td>(51)</td>
</tr>
<tr>
<td>Canada geese</td>
<td>177 ± 5.5</td>
<td>141 ± 5.2</td>
<td>112 ± 5.6</td>
<td>Dorsal metatarsal</td>
<td>6</td>
<td>(52)</td>
</tr>
<tr>
<td>Great horned owls</td>
<td>232 ± 37</td>
<td>203 ± 28</td>
<td>178 ± 25</td>
<td>Brachiocephalic</td>
<td>6</td>
<td>(53)</td>
</tr>
<tr>
<td>Red-tailed hawks</td>
<td>220 ± 51</td>
<td>187 ± 42</td>
<td>160 ± 45</td>
<td>Brachiocephalic</td>
<td>6</td>
<td>(53)</td>
</tr>
</tbody>
</table>

N — total number of animals.
these should meet the same standards for validation of any BP monitor that measures mean arterial BP. While a number of studies in the veterinary literature have utilized these criteria in an attempt to validate NIBP monitors in conscious and anesthetized veterinary species, a recent study suggested limited utility of these validation criteria stating that they are designed for the detection of hypertension in conscious animals (21).

The level of agreement between 2 different assays can be assessed using a Bland-Altman plot, and is the most appropriate statistical method to compare the performance of a NIBP monitor to direct arterial BP values (gold standard method). If an NIBP monitor is to be used interchangeably with direct arterial BP monitoring, the bias (mean of the differences between the 2 methods) should be small and the limits of agreement (standard deviation) should be < 30%. The importance of critical evaluation of the statistical comparison of 2 techniques has been reviewed (22) and it is necessary that the assumptions of the Bland-Altman plot be met when used for statistical analysis; these include, constant bias, constant variability, normality, and independence of the values (22). It has been suggested that since the correlation coefficient does not measure level of agreement but only the linear relationship between the values it is not a useful parameter in BP method comparison studies (22). However, since there are no other standards, the AHCP-VBPS Validation criteria of the ACVIM are the only guidelines available to follow (18).

Techniques for non-invasive blood pressure measurement

Non-invasive blood pressure monitoring techniques are frequently used in veterinary practice. Techniques that have been evaluated in veterinary species include auscultatory, Doppler ultrasonic flow detector, oscillometry, high definition oscillometry, and plethysmography. The most commonly used techniques are Doppler and oscillometry (3,23). The first measurement of arterial BP in any species was taken in 1731 in a horse when arterial BP is being measured (25,26). These recommendations have been adopted for cats (27) and carried across species for which the same guidelines have not been established (28,29).

Appropriate cuff size and position is an important consideration for obtaining accurate results when using NIBP measurement techniques. A cuff that is too narrow or too loose tends to overestimate arterial BP, whereas a cuff that is too wide or too tight tends to underestimate arterial BP values (1,3). In dogs, the recommended cuff width is 30% to 40% of the circumference of the appendage (forelimb, hind limb, or tail) from which arterial BP is being measured (25,26). These recommendations have been adopted for cats (27) and carried across species for which the same guidelines have not been established (28,29).

Recently, a new study evaluated the use of a conical shaped cuff compared to the traditional cylindrical cuff, placed on the antebrachium over the median artery, for oscillometric BP measurement in dogs. Data from the conical shaped cuff had poor agreement with direct arterial BP values (30). The inflatable portion of the cuff should be positioned directly over the artery to be compressed and the appendage from which BP is being measured should be positioned at the same level as the heart.

Auscultatory technique

The auscultatory, or Riva-Rocci, technique was first developed in the 19th century and is the gold standard technique used to measure arterial BP in human patients (4). The technique utilizes an inflatable cuff, a sphygmomanometer, and a stethoscope. The principle of the technique is that blood flowing through a peripheral artery creates vibrations of the vessel wall and a low frequency sound that is audible to the human ear (4). The cuff is placed around the peripheral artery of an extremity with the bell of the stethoscope placed over the audible pulse distal to the cuff. When the cuff is inflated to a pressure that exceeds systolic arterial BP, inhibiting blood flow, the audible pulse disappears. Then the cuff pressure is slowly deflated until the first audible sound returns and the pressure at this point is taken to be the systolic arterial BP value. The cuff pressure at which the last audible sound is detected is taken to be the diastolic arterial BP value (4). If systolic and diastolic arterial pressures are known, mean arterial BP can be estimated using the following equation:

\[
MAP = \frac{SAP + 2 \times DAP}{3}
\]

Equation 2

As previously mentioned, this technique has limited clinical utility in veterinary species. The technique was evaluated in a group of anesthetized dogs with the arterial sounds amplified using a contact microphone to make them audible and the measurements were found to be comparable to those taken via a direct arterial catheter (24). Nevertheless, in veterinary patients the arterial (Korotkoff) sounds are of low amplitude and frequency making them non-audible to the human ear, thus making the clinical utilization of this technique challenging (24,31).

Optical plethysmography

Plethysmography is the determination of changes in volume by means of a plethysmograph. In order to use it for the estimation of arterial BP, the plethysmographic display of the pulse oximeter is required (32). In veterinary species this technique requires a pulse oximeter that displays the pulse pressure waveform, an inflatable cuff and a sphygmomanometer. The pulse oximeter probe is placed on a distal extremity or the tongue and the occlusive cuff is placed proximally. The cuff is inflated until the plethysmographic waveform is no longer visualized on the display and then the cuff is slowly deflated until the waveform returns. The cuff pressure that allows visualization of the waveform is taken to be the systolic arterial BP (32).

Studies evaluating this technique in veterinary species are limited; however, it has been assessed in dogs (32) and cats (33). Optical plethysmography was evaluated on the tongue in a group of 20 dogs in which anesthesia was induced with propofol or thiopental and maintained with isoflurane in 100% oxygen. The technique was assessed over a wide range of blood pressures
and was found to be within 10 mmHg for 95% of direct systolic arterial BP values $\leq 85$ mmHg, for 70% of values between 90 and 120 mmHg, and for 30% of values $\geq 125$ mmHg (32). Therefore, the bias (mean value of the difference between the plethysmography value and direct arterial pressure value) and precision (2 standard deviations of the difference) showed the best agreement ($-2 \pm 6$ mmHg; $r = 0.86$) at low systolic arterial BP values and least ($-18 \pm 13$ mmHg; $r = 0.55$) at high systolic arterial BP values. The authors concluded that this is an acceptable method of arterial BP measurement in anesthetized dogs. According to the criteria recommended by the AHCP-VBPS Validation, most criteria were met in this study, with the lower values of systolic arterial BP, except for the correlation value, which was $< 0.9$ for all ranges of systolic arterial BP.

In 8 isoflurane–anesthetized cats, optical plethysmography was evaluated on the thoracic limb during conditions of 3 systolic arterial BP ranges: 80 to 100 mmHg, 60 to 80 mmHg and $< 60$ mmHg (33). In comparison with the direct method, plethysmography consistently underestimated systolic arterial BP and was found to have a large bias ($-25 \pm 7.5$ mmHg) (33), and these values are unacceptable for the AHCP-VBPS Validation. However, when the plethysmography value was compared with direct mean arterial BP, the bias was minimal and precision was improved ($0.6 \pm 5.5$ mmHg; $r = 0.9$), leading the authors to conclude that optical plethysmography in cats may be a better predictor of mean arterial BP than of systolic arterial BP (33). These values comply with the AHCP-VBPS Validation, but it is clear that these values do not represent the intended systolic arterial BP comparison.

**Doppler ultrasonic flow detector**

The principle of determining arterial BP using Doppler is similar to the auscultatory method except that a distally placed flow detector is utilized instead of a stethoscope to amplify the arterial sounds. The Austrian physicist and mathematician Christian Doppler first described the principle of the Doppler effect in 1842 (34). Ultrasonic Doppler flow detectors have a Doppler probe, which contains 2 piezoelectric ultrasound crystals. The first of the 2 crystals is the transmitting crystal, which transmits ultrasound energy through the skin, deep tissues, and arterial wall and the second is the receiving crystal, which receives the echo that is reflected from the tissues (3,23,35). A stationary structure will reflect an echo of the same frequency back to the receiving crystal; however, a structure in motion, such as red blood cells, will reflect an echo of different, or “shifted” frequency. The Doppler-shift is the difference in frequency between the transmitted ultrasound signal and the echo that is received back. The phase-shifted ultrasound waves are then transformed into an audible signal, with frequencies proportional to the velocity of the reflecting surface (3,34,35).

To utilize this principle to measure arterial BP, ultrasonic gel, which serves as a conductive medium, is placed on the surface of the Doppler probe and the probe is then placed over a peripheral artery, from which the hair has been clipped. An occlusive cuff is placed proximally and a sphygmomanometer is used to inflate the cuff until blood flow, and therefore systolic arterial BP, is impeded, causing the audible signal to disappear (3,23).

The cuff is slowly deflated and the cuff pressure at which the first audible sound returns should correspond to the highest pressure in the vessel; a systolic arterial BP value. However, in veterinary species there is discrepancy between systolic arterial BP measured with Doppler technology and direct systolic arterial BP measured via catheterization of various peripheral arteries, and in some instances can be more reflective of the measured direct mean arterial BP; this is thoroughly described in part 2 of this review.

In addition to being minimally invasive, the Doppler technique is advantageous in that it is inexpensive, easy to use, has utility in a variety of patient sizes, and provides a consistently audible pulse signal. However, the accuracy and effectiveness of the Doppler are affected by motion of the patient and it is often difficult to obtain an audible signal in patients experiencing peripheral vasodilation.

**Oscillometry**

Oscillometric BP monitors are automated devices that provide estimates of systolic, mean, and diastolic arterial BP, in addition to heart rate (1,23). Oscillometric devices automatically inflate the occlusive cuff until arterial blood flow is impeded (no arterial wall vibrations or oscillations are detected). As the pressure in the cuff is slowly deflated, the oscillometer measures the mean arterial BP as the value at which the pressure oscillations in the cuff have maximum amplitude and an algorithm is used to compute systolic and diastolic arterial BP values from the measured mean arterial BP (1,4,23). The algorithm varies between monitors and thus so can the displayed estimate of arterial BP values (23). The mean arterial BP is considered to be the most accurate BP value from oscillometric monitors because it is the measured parameter, whereas the systolic and diastolic arterial BP values are estimated.

Oscillometric monitors are simple and easy to use and some monitors have the advantage of being automated such that BP readings can be taken at set time intervals and stress to the patient from repeated handling can be minimized. However, they may be less accurate in very small patients, patients with very rapid heart rates, arrhythmias, or systemic vasodilation, hypotensive animals with low pulse pressure or during patient movement (restlessness, shivering, seizure activity).

**High definition oscillometry**

High definition oscillometric BP monitors introduce a new technology for non-invasive measurement of arterial BP and have been evaluated in a few veterinary species (36–39). The technology allows pulse detection of up to 600 beats/min and detects a wider range of pressures (0 to 450 mmHg) compared to standard oscillometry (40). The monitor also displays real time pulse wave analysis such that arrhythmias or artifact can be visualized (40). During BP measurement, high definition oscillometry (HDO) initially evaluates the pulse rate of the animal and adjusts the rate of cuff deflation accordingly for subsequent readings (40). High definition oscillometry also differs from standard oscillometry in that the technology directly measures systolic, mean, and diastolic arterial BP values making the monitor, in theory, more accurate than traditional oscillometric.
monitors that utilize algorithms to compute systolic and diastolic arterial BP.

Clinical use and interpretation of BP values obtained via NIBP measurement

The gold standard for arterial BP measurement in veterinary species is via direct arterial catheter placement. Clinically, direct arterial BP monitoring is indicated for animals that are in shock, hemodynamically unstable, high anesthetic risk, severely hypertensive, requiring sympathomimetic support, or receiving mechanical ventilation (41). Due to the wide variation of arterial BP across veterinary species (Table 2), direct arterial BP monitoring may also be indicated during anesthesia in those species in which normal values are unknown and in large animal species in which adequate muscle perfusion is crucial to the animal’s recovery. Direct arterial BP monitoring is technically demanding, invasive, and costly, and it is therefore not indicated for every animal. Additionally, the placement of an arterial catheter in animals at high risk of bleeding (coagulopathic) or infection may make direct arterial BP monitoring more detrimental than beneficial. The above-mentioned NIBP monitoring techniques provide good alternatives to direct arterial BP evaluation in certain populations. The greatest limitation to NIBP monitoring is its inaccuracy, particularly in hypotensive or hypertensive animals and in certain species. However, the ease of use, availability, non-invasiveness, and lower cost make NIBP monitoring advantageous in healthy, stable, and low risk or elective anesthetic cases (41).

Perhaps the biggest challenge veterinarians face when using NIBP monitors is recognizing the accuracy, or inaccuracy, of the results and how they should be interpreted. Critical evaluation of the reference literature is important. As discussed, consideration of the non-invasive monitor used, animal population studied, how measurements of BP were taken and methods of statistical analysis are all important. Non-invasive monitors can vary in performance based on manufacturer algorithm and study results do not necessarily translate across devices. Blood pressure values differ across veterinary species (Table 2) and if an animal is conscious or anesthetized (Table 1); therefore, findings of monitor performance in one study cannot be extrapolated to another species nor can findings in conscious animals be translated to anesthetized animals. Any simultaneous administration of drugs that alter cardiovascular performance needs to also be considered as these can affect BP values and monitor performance (6,12). Finally, the method of statistical comparisons of direct arterial BP readings to non-invasive arterial BP measurements and the arterial location from which both were measured can impact the results (5,7). All of these factors must be contemplated when making final decisions on the performance of an NIBP monitor.

Reviewing the literature shows that, although much work has been done and continues to be done to evaluate NIBP measurement across a variety of veterinary species, a general conclusion with respect to NIBP monitors cannot be made for all veterinary species. However, although definitive conclusions within species are difficult, some trends have been identified that are discussed in Part 2 of this review.

In conclusion, evaluation of arterial BP has great utility in veterinary species and the NIBP measurement devices available vary greatly between techniques and how they determine estimations of arterial BP. The biggest challenge when using NIBP monitors is the proper interpretation of the BP values provided when using them to guide veterinary patient management and treatment. In the second part of this 2-part review the veterinary literature evaluating the use of NIBP measurement techniques in conscious and anesthetized species will be critically evaluated such that general conclusions for proper use and interpretation of these devices can be formed.

References

17. Steggiou GS, Alpert B, Miele S, et al. A universal standard for the validation of blood pressure measuring devices: Association for the Advancement of Medical Instrumentation/European Society of
Internet survey of feeding, dietary supplement, and rehabilitative medical management use in flyball dogs

Ronald Koh, Christina Montalbano, Lauri Jo Gamble, Katherine Walden, Jennifer Rouse, Chin-Chi Liu, Lauren G. Wakshlag, Joseph J. Wakshlag

Abstract — A survey was designed to investigate the prevalence and characteristics of feeding, dietary supplement use, and rehabilitative management use in flyball dogs. The survey was completed by 394 respondents. There were 12.5% (n = 49/392) and 33.4% (n = 131/392) of owners who fed home-cooked and raw diets, respectively, to their dogs. About 77.7% (n = 306/394) and 56.6% (n = 223/394) of owners used dietary supplement and rehabilitative management, respectively, primarily joint supplements (89.8%, n = 275/306) and chiropractic (73.1%, n = 163/223). Owners were more likely to use supplements (P = 0.0002) and rehabilitative management (P = 0.0001) when their dogs were injured. Dogs with more than one reported injury received rehabilitative management (P < 0.0001) and used supplement (P = 0.0006) more often.

Key clinical message: There is considerable demand for non-commercial food, supplements, and rehabilitative management among flyball dog owners, underscoring the importance for veterinarians to understand the motivation of dog owners’ decisions as well as the risks and benefits of these practices to ensure optimal outcomes for their patients.

Résumé — Sondage par internet sur l’alimentation, les suppléments nutritifs et la gestion médicale de réadaptation de chiens pratiquant le flyball. Un sondage a été élaboré afin d’étudier la prévalence et les caractéristiques de l’alimentation, l’utilisation de suppléments nutritifs et la gestion de l’utilisation de la réadaptation chez les chiens pratiquant le flyball, Le sondage fut complété par 394 répondants. Il y avait 12,5% (n = 49/392) et 33,4% (n = 131/392) des propriétaires qui nourrissaient leurs chiens avec une alimentation cuite maison et une alimentation crue, respectivement. Environ 77,7% (n = 306/394) et 56,6% (n = 223/394) des propriétaires utilisaient des suppléments nutritifs et une gestion de réadaptation, respectivement, principalement des suppléments articulaires (89,8%, n = 275/306) et de la chiropractie (73,1%, n = 163/223). Les propriétaires étaient plus enclins à utiliser des suppléments (P = 0,0002) et une gestion de réadaptation (P = 0,0001) lorsque leurs chiens étaient blessés. Les chiens avec plus d’une blessure rapportée ont reçu une gestion de réadaptation (P < 0,0001) et utilisaient des suppléments (P = 0,0006) plus souvent.

Message clinique clé : Il y a une demande considérable pour des aliments non-commerciaux, des suppléments et une gestion de la réadaptation chez les propriétaires de chiens pratiquant le flyball, soulignant l’importance pour les vétérinaires de comprendre la motivation des propriétaires de chiens dans leurs décisions aussi bien que les risques et bénéfices de ces pratiques afin d’assurer les meilleurs résultats pour leurs patients.

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Introduction

Flyball, a team sport for dogs and handlers, has increased in popularity and has governing organizations across the world. The flyball course consists of 2 teams of 4 dogs competing side-by-side on separate parallel lanes with 4 hurdles spaced 3 m apart and a spring-loaded flyball box in which a tennis ball is loaded. Dogs are released from the start line, stride over the 4 hurdles in sequence, retrieve a ball from the box, and return over the hurdles again to pass on the start line, with the winning team having a lower overall elapsed time for the course (1,2). Unlike agility sports, there has been limited study reported on the injuries in flyball dogs (3). However, given that flyball is a sprinting canine sport similar to agility, parallels can be drawn for comparison. Agility dogs sustain injury with a prevalence of approximately 1/3 (33%) of the dogs experiencing at least 1 injury and more than 1/4 (27.6%) of the dogs experiencing more than 1 injury during agility training or competition (4–6). The most commonly injured regions are the shoulder and back (7–9). To the authors’ knowledge, the prevalence of rehabilitative medical management for sport-related injury has not been reported for flyball dogs.

The use of dietary supplements has steadily increased among the pet population in recent years (10); however, little is known about current trends in dietary supplement use in the canine sporting populations. Additionally, only limited information is available regarding feeding trends among dogs that participate in agility events. In 2017, Dinallo et al (11) conducted a survey of North American agility dog owners, with responses received for 494 dogs. They found that 61% of owners fed primarily commercial dry food, 25% fed foods other than commercial dry (i.e., home-cooked, raw or freeze-dried), 14% fed a mixture of commercial dry food and raw/home-cooked blend, and 62% of owners used dietary supplements (11). To the authors’ knowledge, the prevalence of feeding type and dietary supplement use in flyball dogs is unknown.

The first objective of this study was to determine the prevalence and characteristics of feeding trends, dietary supplement use, and rehabilitative medical management among flyball dogs. The second objective was to investigate whether the number of injuries influence the use of dietary supplements and medical management. We hypothesized that there would be a higher prevalence of dietary supplement use and feeding of home-cooked or raw diets amongst flyball dog owners than has been reported in the general dog population, and that dog owners would be more likely to use dietary supplements and rehabilitative medical management modalities when their dogs incurred a flyball-related injury.

Materials and methods

The survey consisted of 121 questions adapted from a previous questionnaire with tailoring of questions specific to flyball participants regarding gear (i.e., harnesses and carpal wraps), activities (i.e., turnstiles, etc), injury history, types of food, dietary supplements, and rehabilitative medical management (6). Prior to implementation of the survey, all questions were validated for accuracy and comprehension by mock interviews of 10 individual dog owners involved in flyball activity. After revisions, the survey was uploaded into a prescription online Survey Monkey (SurveyMonkey, San Mateo, California, USA) software. The survey was completed either onsite at 1 of 8 flyball events by 2 veterinarians (LJG, KW), or online at their convenience following instructions provided by the interviewers. Responses were collected between March 11, 2017 and December 14, 2017. For the study, we included only data on the prevalence and characteristics of feeding trends, dietary supplement use, and rehabilitative medical management. The survey results of risk factors for injury in flyball dogs are reported elsewhere.

Data collected included dog age, sex, spay or neuter status, and breed as general demographic data. Feeding was categorized into primarily i) commercial, home-cooked, raw and/or freeze-dried (calculated as 75% or greater as main meals); and ii) a mixture of commercial and home-cooked, raw and/or freeze-dried. Respondents were also asked about the feeding management they currently used in their dogs, for example administered food type, quantities, frequencies, duration, restriction of food on competition days, and change of feeding strategies or foods based on current training or activity level. The prevalence of commercially available supplements regularly used in flyball dogs was investigated and categorized into:

- joint supplements (e.g., glucosamine/chondroitin, fish oil);
- focus supplements (e.g., ginkgo biloba, Senilife);
- skin/coat supplements (e.g., fatty acid, vitamins);
- performance supplements (e.g., creatine, maltodextrin, glucose/glycogen repletion);
- heat stress supplements (e.g., glycerol, electrolytes);
- stress diarrhea supplements (e.g., fibers, slippery elm);
- antioxidant supplements (e.g., vitamin E, vitamin C);
- vitamin supplements (e.g., multivitamin, Pet tabs); and
- “other” supplements.

Supplements that were only used during competitions to enhance performance or improve recovery were categorized into electrolytes, glucose supplements, fat supplements, antioxidants, protein supplements, and “other” supplements. The rehabilitative medical management modalities were categorized into physical rehabilitation, laser therapy, therapeutic ultrasound, transcutaneous electrical nerve stimulation (TENS), electromagnetic field device (PEMF), acupuncture, chiropractic, massage and manual therapy, heat and/or cold packing, brace-wrap, use of an orthotic or other immobilization device, and other modalities. Most questions in the survey were closed-ended with choices indicated by check boxes and the opportunity to indicate “other” and provide a text explanation if an appropriate choice was not available. Some questions also included comment boxes so that respondents could provide additional details if desired.

Statistics

All data were collected from the survey and entered into a Microsoft Excel spreadsheet (Microsoft, Redmond, Washington, USA) and spot-checked for accuracy. All descriptive statistics were presented as percentages of total population or portion of the population being examined. Data analyses were performed using JMP Pro 14.2.0 (SAS Institute, Cary, North Carolina, USA). Continuous variables were evaluated using the Shapiro-Wilk
test. Normally distributed data were reported as the mean and standard deviation (SD), while non-normally distributed data were reported as the median and range. The association between pairwise ordinal parameters was assessed by Spearman’s rank-order correlation, “r.” The association with a categorical variable was evaluated with the Mann-Whitney rank sum test for continuous variables and with Chi-square test of independence ($\chi^2$ test) for categorical variables. Significance was set at $P < 0.05$.

**Results**

**Participant characteristics**

Completed surveys were received from 413 respondents. Not all respondents answered every question; 394 respondents completed data that could be used for analysis of supplements and medical management, whereas 392 respondents completed data for feeding analysis. The study population consisted mainly of spayed female dogs (41.1%, $n = 162/394$), followed by neutered male dogs (38.8%, $n = 153/394$), intact male dogs (11.9%, $n = 47/394$), and intact female dogs (8.1%, $n = 32/394$). Dogs were a median age of 5 y (with 1 y being the lowest age category and $> 10$ y being the highest, and each year in between). The median body weight was 15.4 kg (range: 3.6 to 38.1 kg), and the median body condition score (BCS) was 4 (range: 1 to 6) on the 9-point scale. With 61 breeds represented, most study dogs were mixed or unknown breed (31.2%, $n = 123/394$). Among the 394 dogs, the most common purebred was the border collie (27.9%, $n = 110$), followed by the Shetland sheepdog (22.6%, $n = 89$), Australian shepherd (5.6%, $n = 22$), whippet (4.3%, $n = 17$), Labrador retriever (3.8%, $n = 15$), and Jack Russell terrier (2.3%, $n = 9$), with a variety of other purebreds reported in fewer numbers (2.3%, $n = 9$).

**Feeding patterns**

In the study, 392 of the 394 respondents completed the feeding data for analysis. Most dogs (88.0%, $n = 345/392$) were fed 2 times a day while the remaining dogs were fed once a day (12.0%, $n = 47/392$). Feeding patterns showed that 60.5% ($n = 237/392$) of the respondents fed primarily commercial kibble or canned food, 16.8% ($n = 66/392$) fed a mixture of commercial and home-cooked ($n = 45/66$) or raw food ($n = 21/66$), 12.5% ($n = 49/392$) fed non-traditional commercial food (primarily raw, freeze dried), and 10.2% ($n = 40/392$) fed primarily home-cooked or raw food. Among the 10.2% respondents, 92.5% ($n = 37/40$) of dogs were fed primarily raw food, and 7.5% ($n = 3/40$) of dogs were fed home-cooked food. Home-cooked diet either as primary or mixed meals was fed to 12.2% ($n = 48/392$) of dogs. Raw food diets either as primary meals or at least 25% as main meals were fed to 33.4% ($n = 131/392$) of dogs in the form of either commercial or home-prepared food. For those respondents who provided home-cooked or raw food as primary meals ($n = 40/392$) or mixture of the diet ($n = 66/392$), only 14.2% ($n = 15/106$) based their dog’s main dietary regimen on the advice of a veterinarian, with 6.6% ($n = 7/106$) from their primary veterinarian and 7.5% ($n = 8/106$) from a board-certified veterinary nutritionist. In contrast, 85.8% ($n = 91/106$) of the respondents

![Figure 1. Categories of dietary supplements used in flyball dogs. Total number of dogs receiving one or more supplements, $n = 306/394$.](image)
were using recipe formulations obtained from non-veterinarian resources, including 33.9% ($n = 36/106$) based on Internet resource, 20.8% ($n = 22/106$) from friends or colleagues, 11.3% ($n = 12/106$) from breeders, 8.5% ($n = 9/106$) from books, and 10.4% ($n = 11/106$) reported “other” as a source of information.

**Dietary supplements**

In the study, 77.7% ($n = 306/394$) of the respondents reported that they currently gave their dog dietary supplements. Of these, 34.0% ($n = 104/306$) were given 1 type of supplement, 27.8% ($n = 85/306$) received 2 types of supplements, 18.0% ($n = 55/306$) had 3 types of supplements, 11.4% ($n = 35/306$) were given 4 types of supplements, 4.6% ($n = 14/306$) consumed 5 types of supplements, and more than 5 but less than 8 types of supplements were given to 4.2% ($n = 13/306$) of dogs. As shown in Figure 1, the most common dietary supplements were joint supplements (89.9%, $n = 275/306$), followed by skin/coat supplements (44.1%, $n = 135/306$), performance supplements (30.1%, $n = 92/306$), stress diarrhea supplements (25.5%, $n = 78/306$), antioxidant supplements (19.9%, $n = 61/306$), heat stress supplements (18.3%, $n = 56/306$), vitamin supplements (16.0%, $n = 49/306$), and focus supplements (12.7%, $n = 39/306$). Additionally, owners feeding home-cooked or raw diet and non-traditional commercial dog food were significantly more likely to give their own dog dietary supplements as well ($\chi^2 = 15.246, P = 0.009$).

During competitions, about 24.4% ($n = 96/394$) of respondents gave dietary supplements to enhance performance. The most commonly used dietary supplements for enhancing performance were electrolytes (53.1%, $n = 51/96$), followed by protein supplement (20.8%, $n = 20/96$), glucose supplement (10.4%, $n = 10/96$), fat supplements (10.4%, $n = 10/96$), and antioxidants (5.2%, $n = 5/96$).

**Medical treatment**

Of the 394 respondents, 56.6% ($n = 223/394$) of the dogs received at least 1 of the following treatments for a chronic injury or for wellness: physical rehabilitation, laser therapy, therapeutic ultrasound, pulsed electromagnetic field therapy (PEMF), acupuncture, chiropractic, massage and manual therapy, heat and/or cold packing, brace/wrap, orthotic or other immobilization device. As shown in Figure 2, the 5 most commonly used modalities were chiropractic (73.1%, $n = 163/223$), massage and manual therapy (56.5%, $n = 126/223$), laser therapy (43.0%, $n = 96/223$), physical rehabilitation (29.1%, $n = 65/223$), heat and/or cold packing (20.2%, $n = 45/223$), and acupuncture (12.1%, $n = 27/223$). The least common treatments included therapeutic ultrasound (4.9%, $n = 11/223$), immobilization devices (4.0%, $n = 9/223$), PEMF (1.8%, $n = 4/223$), and TENS (0%, $n = 0/223$). Among the respondents who used medical management for their dogs, 30.0% ($n = 67/223$) received 1 treatment modality, 30.9% ($n = 69/223$) received...
2 modalities, 17.5% ($n = 39/223$) received 3 modalities, 10.3% ($n = 23/223$) received 4 modalities, and 11.2% ($n = 25/223$) received $\geq 5$ but $< 8$ modalities.

**Injury report**

Of 394 dogs, 38.8% ($n = 153/394$) were reported injured. Approximately 69.3% ($n = 106/153$) of dogs sustained 1 injury, 16.3% ($n = 25/153$) had 2 injuries, 6.5% ($n = 10/153$) suffered 3 injuries, and 7.8% ($n = 12/153$) incurred more than 3 injuries. Injuries were further categorized into acute injury (68.6%, $n = 105/153$) and chronic injury (31.4%, $n = 48/153$). When the dog was injured, nearly 3/4 of respondents (70.6%, $n = 108/153$) sought veterinary attention, 20.9% ($n = 32/153$) of respondents removed their dog from competition, and the remaining 8.5% ($n = 13/153$) either continued activity as usual or pursued “other” as a course of management for their dog. Owners were significantly more likely to use medical management ($\chi^2 = 25.768, P = 0.0001$) and dietary supplements ($\chi^2 = 13.829, P = 0.0002$) for their dog with 1 or more injuries. Dogs which suffered more than 1 injury were significantly more likely ($p = 0.2978, P < 0.0001$) to have more rehabilitative medical modalities performed and to have greater supplement use ($p = 0.1742, P = 0.0006$). However, there were no other significant differences between acute and chronic injury in medical management ($\chi^2 = 0.4366, P = 0.4380$) and supplement use ($\chi^2 = 0.4642, P = 0.4657$).

**Discussion**

This is the first examination of flyball management as it relates to feeding practices, supplement use, and veterinary rehabilitative care. Prior feeding and supplement practices in agility dogs were reported with an abnormally high number of respondents using home-cooked or raw diets (25%) and supplements (62%), compared to a 2008 survey (12) which reported that approximately 3% of dogs were fed primarily raw or home-prepared foods and only 13.2% of dogs utilized supplements. Although most dogs in this study were fed primarily commercial kibble or canned food, there was a high incidence of feeding home-cooked and raw diets among flyball dogs in the United States. The rates of dogs feeding home-cooked or raw diet either as a sole source of nutrition or a mixture in the study were consistent with results from a previous survey of agility dogs (11), but are much higher than results in other reports (13–15). Additionally, there appears to be increasing interest in using raw food diets among flyball dog owners. The frequent consumption of raw diets either as a primary meal or at least 25% of their dog’s diet was 1 in 3 dogs in the present study which is the highest reported to date in a cohort of dogs. Pet owners make the decision to feed their pet a home-cooked or raw diet for many reasons including pet health problems, distrust of the commercial pet food industry, the belief that home-cooked or raw food is healthier, a desire to use or avoid certain ingredients, or anthropomorphism of pets (14–17). Such diets may also be used by owners of sporting or working dogs with the thought of meeting nutritional and energy demands, enhancing performance, or providing supplemental protein, fat, or calories. Home-cooked or raw diets allow pet owners to select diets based on an assessment of ingredient quality and sourcing, safety and transparency, and customization and variety. The humanization or anthropomorphism of dogs by their owners is a growing trend driving more dog owners to increase amount of time, effort, and money on providing care for their dogs as an expression of deep caring and passionate devotion to them (18). More owners consider that providing a specific kind of food for their pets, such as high-end foods, home-cooked or raw foods, organic foods, treats, and supplements, is a way of expressing their strong attachment to their pets, and believing that these foods have health benefits and will lead to particular positive outcomes for their pets (17,19).

While the health benefits remain to be determined, feeding non-commercial or complementary foods may be less nutritious or balanced than desired and, therefore, dogs may be at risk for nutrition-related diseases (20). Veterinarians should make owners who feed such foods to their dogs aware of the risks for potential nutritional imbalances.

Another important finding from the present study was that only 14% of owners reported a veterinarian or Board-certified veterinary nutritionist was their primary resource regarding their pet’s home-cooked diet formulation — a finding that has also been reported in other surveys (15,16). Approximately 76% of the home-cooked diets were formulated by the owners themselves based on non-veterinarian advice, including Internet resources, a friend or colleague, breeder, and a book, as a primary source of information on pet nutrition. Similar to previous studies (12,15,16,21), more than a quarter of owners in this study used Internet resources as their primary source of home-cooked diet formulation. The findings indicate that, as in previous studies, owners who feed home-cooked or raw diets trust veterinarians less than other resources in determining what to feed their pets (13,16,22). This suggests that primary care veterinarians should ask detailed questions to obtain a comprehensive dietary history for their patients involved in flyball activities, and be aware of the nutritional needs of these patients so that they can provide appropriate advice. Considering most self-formulated or published recipes of home-cooked or raw diets have been shown to be nutritionally inadequate with 1 or more nutrient deficiencies, especially for calcium, phosphorus and vitamin D (23–27), the involvement of Board-certified veterinary nutritionists may be best.

Dietary supplement use was common in dogs in the present study. Recently, Dinallo et al (11) showed overall use of any dietary supplement in agility dogs to be 62%, which is slightly lower than the 78% reported in the present study. The prevalence of dietary supplement use herein was considerably higher than those reported by Laflamme et al (12) and Freeman et al (28). The difference in usage may be due to a trend in this specific population of sporting dogs and/or to a universal increase in the number of supplements used since the original survey in 2006 (28). Similar to what was reported by Dinallo et al (11), our survey showed joint supplements were the most commonly used supplements, followed by skin/coat supplements and performance supplements. Additionally, dogs with sport-related injury were more likely to receive supplements from their owners, as previously reported (28). Interestingly, dogs with increased number of injuries in the present study...
were significantly associated with a higher supplement use. The reasons for this association are unclear, but it may be due to the owner’s belief that a combination of supplements may provide more effective pain relief or healing for their injured dog. In addition, the present study found that owners who fed home-cooked diets and non-traditional commercial dog food such as raw foods tend to provide more dietary supplements for their dogs. This might be linked to an overall concern of the owner regarding nutritional intake in their dogs fed home-cooked or raw diets, as they were more likely to be unbalanced and nutritionally inadequate (23–27).

Approximately 24% of owners reported providing a dietary supplement to enhance athletic performance during flyball competitions. Electrolytes are the most commonly used supplements for this purpose, followed by protein supplement, glucose supplement, fat supplements, and antioxidants. Although several supplements have been suggested to improve the performance of racing dogs, no controlled studies have shown any clinical benefit (29). The use of electrolyte supplements is not warranted in sporting dogs if they are being fed a complete and balanced dog food at their metabolic requirement (29). In sled dogs, the use of supplements containing high doses of antioxidants failed to attenuate exercise-induced muscle damage as measured by plasma creatine kinase activity (30). Greyhounds were slower when mock racing track tests were performed in dogs supplemented with 1000 mg of vitamin C (31). The literature suggests that antioxidant and electrolyte use in performance dogs is without merit and owners should be advised as such. The use of maltodextrin–dextrose has advantages in intermediate athletes and there is canine data to suggest its ability to increase muscle glycogen (32). However, in a recent study, Frye et al (33) found that supplement consisting of maltodextrin–dextrose and whey/soya protein had no effect on performance in competitive weight-pulling dogs. Additional research is needed to compare dietary supplement use across a wide variety of canine sports so that sport-specific nutritional requirements and optimization of performance can be established.

To the authors’ knowledge, this is the first report in which medical management for injury or wellness in flyball dogs is reported. The incidence of sport-related injury in flyball dogs in the present study was similar to findings in agility dogs in previous reports (5,6,9). Acute injury was more commonly reported than chronic injury in the study. Despite the type of injury, most owners sought veterinary attention when their dog was injured and had received at least 1 rehabilitative medical treatment modality, with chiropractic being the most commonly used in the study, followed by massage and manual therapy and laser therapy. Therapeutic ultrasound, use of an immobilization device, and PEMF were the least common treatments used in the present study. Additionally, there was a significant increase in the number of rehabilitative medical modalities used by owners when their dogs incurred more injuries. Intuitively, it makes sense that dogs with a greater number of injuries would require a multimodal treatment approach to more adequately and comprehensively address pain and facilitate functional recovery in the affected region (34). However, when duration of injury (acute and chronic) was assessed statistically, there was no association with the number of medical management modalities or supplements used in dogs. Thus, it is unlikely that acute or chronic pain/injury is the main factor influencing the owners’ decision to implement use.

The present study was not without limitations. Primarily, recall bias may have been a major factor since data were collected retrospectively and reported by respondents without verification of the responses. Secondly, owners in this population may not be representative of all flyball dog owners: owners of dogs with a greater personal interest in study results or greater personal experience with dogs injured in sporting-related activities might be more likely to complete the survey. Nevertheless, the incidence of injury in the present study is consistent with previous surveys (5,6,9), making this issue less concerning. Thirdly, in the present study, no definitive veterinary diagnosis was required for confirmation of the dog’s injury as reported by the owners. Finally, the present study did not specifically compare geographical location of owners or the travel distance to a veterinarian with rehabilitation modalities which may have influenced our outcomes.

In conclusion, the current study showed that rehabilitative medical management modalities are commonly used by owners to manage sport-related injury in their dogs and dogs that have more injuries are treated with more modalities. Additionally, our results suggest that there is an increased trend in feeding home-cooked or raw diets, and dietary supplements among flyball dog owners. As such, veterinarians should be aware of this growing interest in non-commercial diets, complementary foods, and dietary supplement use among owners. A comprehensive dietary evaluation should be undertaken and dietary advice provided to ensure that the home-cooked or raw diet is complete and balanced, and to ensure that the owners are aware of potential risks if raw food diets or supplements are fed. Additionally, understanding the owner’s attitudes toward pet food and supplement use could help veterinarians in their educational role. Furthermore, the use of home-cooked or raw diet, the incidence of injury, and the number of injuries were all found to influence dietary supplement use in the current study, just as the number of injuries was also found to increase modalities used in the recovery process.

References


Gastrointestinal nematode management in western Canadian cow-calf herds

Felicity K. Wills, John R. Campbell, Sarah E. Parker, Cheryl L. Waldner, Fabienne D. Uehlinger

Abstract — There is a paucity of information from western Canadian beef cow-calf producers about how they control gastrointestinal nematodes. The objectives of this study were to describe cow-calf producers’ management practices related to control of gastrointestinal nematodes including pasture management and use of parasite control products. A questionnaire was distributed to 105 producers in May 2015. Responses from 97 producers revealed the almost uniform dependence on the use of a pour-on macrocyclic lactone parasite control product in the fall as part of a routine farm management program. Control of external parasites was the primary reason for treatment, while none of the producers chose to treat specifically to manage internal parasites. The predominant management practices identified through this study increase the risk of development of anthelmintic resistance. The results also highlight the need to raise awareness of the importance of an evidence-based gastrointestinal nematode control program in beef cow-calf herds.

Introduction

All grazing cattle are exposed to gastrointestinal nematodes (GIN) and GIN burden contributes significantly to productivity loss in grazing herds (1). While it is challenging to quantify the economic costs of GIN burden in cow-calf herds because production effects are mostly subclinical, meta-analysis of 170 trials suggested a 2.5× greater economic benefit of GIN management to the cattle industry than the use of growth promotors (2,3).

Presently, most livestock producers administer anthelmintic treatments without diagnostic or epidemiological evidence (4). Such approaches place selection pressure on parasite populations, resulting in a reduction in parasite refugia (5,6). A reduced refugia population has been associated with development of anthelmintic resistance (AR) (7). In addition to routine “blanket” treatment as a main GIN management strategy, other choices made by producers are likely responsible for the growing reports of AR in various GIN species (8).
Pasture management is also important in cattle exposure to infective third stage GIN larvae (L3). The overarching aim of pasture management related to GIN control is to reduce pasture contamination with L3 to produce “safe” pastures, and to reduce animal exposure to heavily contaminated pastures (9).

There is a paucity of information from western Canadian beef cow-calf producers about their current opinions on GIN in their herds and how they control GIN. Increasing reports of AR highlight the need to develop strategies that integrate chemical deworming with animal and pasture management practices (6,10). However, in order to recommend economical and practical GIN control practices it is important to understand the current animal and pasture management strategies and producer opinions on GIN burdens (11). Therefore, the objectives of this study were to: i) describe the current cow-calf pasture and cattle management practices as they may relate to GIN burden; and ii) define cow-calf producers’ opinions towards and sources of information on GIN management.

Materials and methods

Study population
Participating producers were part of the Western Canadian Cow-Calf Surveillance Network (WCCCSN). Producer recruitment into the WCCCSN has been previously described (12,13). Briefly, enrolment was based on the last Canadian agricultural census available prior to recruitment and considered a geographically representative sample of cow-calf enterprises in the 3 prairie provinces (Alberta, Saskatchewan, and Manitoba) (14).

Producers were recruited through their herd veterinarians. Participation was contingent on a minimum herd size of 100 cows, and a willingness to complete questionnaires and allow biological sample collection. In May 2016, 105 herds were enrolled in the WCCCSN (52 in Alberta, 34 in Saskatchewan, and 19 in Manitoba) and producers associated with these herds were invited to participate in this questionnaire. Based on the preference stated at recruitment in the WCCCSN, questionnaires were administered through mailed hard copies or web formats. Multiple reminders, including a hard copy of the questionnaire, were sent to all producers who had not returned their questionnaire by August 2016.

Questionnaire design
The questionnaire consisted of 22 questions divided into 2 parts and comprising short answer, multiple-choice, and rating questions. The first section focused on herd demographics and grazing and pasture management of cow-calf pairs and replacement heifers during the spring/summer grazing period of 2015. These questions aimed to gather information about stocking density and the general method of stock/pasture management (e.g., rotation, continuous, intensive or a combination of these) and

Figure 1. Percentage (95% CI) of grazing systems used by herds for cow-calf pairs (n = 97) and replacement heifers (n = 95) during the first 2 mo of the spring/summer grazing period 2015, by herd size. Continuous grazing is defined as cattle having free range and able to determine which areas of the entire pasture available to them they will graze. Rotational grazing is defined as moving cattle through different pasture types, but animal distribution is not directly managed (larger areas grazed for longer durations in rotation). Intensive grazing is defined as the producer determining where, when and what livestock graze at a set stocking rate and directly control animal distribution and movement, using small areas usually grazed for short durations (e.g., 1 wk) and in the same season going back onto the same pasture.
Table 1. Months and frequency (number of producers) of administration of oral parasite control products to cows, replacement heifers, and calves from cow-calf operations in western Canada from May 2014 to May 2016.

<table>
<thead>
<tr>
<th>Month</th>
<th>Cows (n = 4/95 producers)</th>
<th>Replacement heifers (n = 16/93 producers)</th>
<th>Calves (n = 8/45 producers)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Drench</td>
<td>In-feed or mineral mix</td>
<td>Combination (oral and pour-on)</td>
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<td>December</td>
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</table>

In December

- For the purpose of this study, stocking density was categorized as < 0.5 heifer or cow-calf pair/acre, 0.5 to 1 heifer or cow-calf pair/acre, or > 1 heifer or cow-calf pair/acre.

- Continuous grazing was defined as cattle having free range to graze the entire available pasture. Rotational grazing was defined as moving cattle through different pasture types without directly managing animal distribution (larger areas grazed for longer durations in rotation). Intensive grazing was defined as the producer determining where, when, and what livestock graze at a set stocking rate with direct control of animal distribution and movement, utilizing small areas for short durations (e.g., 1 wk) only and reusing the same pasture in that grazing season. Questions regarding stocking density and pasture management were asked specifically about the first 2 mo of the spring/summer grazing season, as this is the period in which the potential for significant pasture contamination with L3 larvae is expected to be greatest (1,15).

- The second section of the questionnaire focused on the current GIN management practices, including the use of parasite control products, producers’ opinions about GIN, and their information sources for GIN management. The survey was pre-tested with 7 cow-calf producers from Saskatchewan who were not enrolled in the surveillance network. An illustrated handbook of parasite control products registered for use in beef cattle in Canada was supplied to aid producers in answering some of the questions.

- Certain management and productivity data for this study population (e.g., breeding, calving, weaning) have previously been published and were not included in this study (16).

**Data analyses**

All responses were entered into a commercial database (Excel 2011; Microsoft Corp., Redmond, Washington, USA) and imported into a statistical software package (StataSE version 14; Stata, College Station, Texas, USA).

Descriptive statistics were performed for each of the survey questions and depicted as frequencies, proportions (95% exact confidence interval [CI]), and mean ± standard deviation (SD) for normally distributed variable, or median [interquartile range (IQR) for non-normally distributed variable). Some questions were not answered by all producers which is reflected in the varying denominators; proportions were calculated using available answers.

Herd size was calculated based on the maximum number of cow-calf pairs reported by each producer for the spring/summer grazing period of 2015. Herd size was categorized into those with ≤ 300 head and those with > 300 head of cattle.

**Results**

**Description of survey responses**

The response rate to the questionnaire was 92% (97/105). There were 51% (49/97) of respondents from Alberta, 35% (34/97) from Saskatchewan, and 14% (14/97) from Manitoba. Producers of herds with ≤ 300 head of cattle made up 71% (69/97) and of herds with > 300 head 29% (28/97) of respondents. Survey responses were received from June 2016 to January 2017; 73% (71/97) were received in June and July 2016. Not all responses were complete; percentages reported are for available responses for each characteristic.

**Breeding herd demographics during the first 2 months of the 2015 spring/summer grazing period**

During the spring/summer grazing period, producers reported a median of 197 (range: 58 to 2700; IQR: 180) cow-calf pairs, 40 (range: 0 to 575; IQR: 56) replacement heifers, and 4 (range: 0 to 84; IQR: 10) dry cows. The median number of breeding management groups on each farm was 5 (range: 0 to 18; IQR: 5). Two producers did not keep replacement heifers. For the largest breeding management group reported by each producer, the median number of cow-calf pairs was 102 (range: 24 to 600; IQR: 109). Both cow-calf pairs and replacement heifers pastured together in 92% (89/97; 95% CI: 84% to 96%) of herds.

**Grazing management characteristics**

Sixty-one percent (58/95; 95% CI: 51% to 71%) of herds started the spring/summer grazing period in May; fewer producers began grazing their herds in June [29% (28/95); 95% CI: 21% to 40%], April [8% (8/95); 95% CI: 4% to 16%] and March [1% (1/95); 95% CI: 0% to 6%].
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length of the grazing period was 158 d (range: 87 to 246 d; IQR: 34 d). The end of the grazing period was October in 53% (50/95; 95% CI: 42% to 63%) of herds, November in 29% of herds (28/95; 95% CI: 21% to 40%), and December in 9% of herds (9/95; 95% CI: 4% to 17%). Five herds (5%; 95% CI: 2% to 12%) ended earlier [September (n = 3), August (n = 1), July (n = 1)]. Three herds (3%; 95% CI: 1% to 9%) ended later [January (n = 2), February (n = 1)].

Rotational grazing alone was the most common grazing system used for cow-calf pairs [46% (45/97); 95% CI: 36% to 57%] and replacement heifers [49% (47/95); 95% CI: 40% to 60%] followed by a combination grazing system approach in cow-calf herds [32% (31/97); 95% CI: 23% to 42%] and a continuous grazing management in replacement heifers [35% (33/95); 95% CI: 25% to 45%]. An intensive grazing system was used by only 3% of cow-calf herds (3/97; 95% CI: 0.6% to 9%) and 3% of replacement heifers (3/95; 95% CI: 0.6% to 9%). When the predominant grazing system was analyzed by herd size, the distribution was similar (Figure 1).

Along with the type of grazing system, producers were asked to describe their stocking density for the largest proportion of cow-calf pairs and replacement heifers. Sixty percent of cow-calf producers (58/96; 95% CI: 50% to 70%) and 59% of those raising replacement heifers (56/95; 95% CI: 48% to 69%) reported a stocking density of ≤ 0.5 cow-calf pairs or heifers/acre, respectively. A stocking density of 0.5 to 1 heifer or cow-calf pair/acre was reported by 27% (26/96; 95% CI: 19% to 37%) and 32% (30/95; 95% CI: 22% to 42%) of cow-calf and replacement heifer producers, respectively. Finally, 13% (12/96; 95% CI: 7% to 21%) and 7% (7/95; 95% CI: 3% to 15%) of cow-calf and replacement heifer producers, respectively, stocked > 1 cow-calf pair or heifer/acre.

For cow-calf pairs, 98% (95/97; 95% CI: 93% to 100%) of producers indicated that their cattle had direct access to surface water (slough and/or dugout). For replacement heifers, 85% (81/95; 95% CI: 77% to 92%) of producers indicated direct access to surface water.

Figure 2. Percent (95% CI) of beef cow-calf producers (n = 97) in western Canada who describe their reason to treat with a parasite control product, by herd size (≤ 300 head, n = 69; > 300 head, n = 28).

TREATMENT WITH PARASITE CONTROL PRODUCTS

Between May 2014 and May 2016, 98% of producers treated cows (95/97; 95% CI: 93% to 100%) and replacement heifers (93/95; 95% CI: 93% to 100%) at least once with a registered parasite control product, while 46% (45/97; 95% CI: 36% to 57%) treated calves at least once. The median number of treatments with a parasite control product per year was 1 in cows (minimum: 1; maximum: 4; IQR: 0.5) and replacement heifers (minimum: 0; maximum: 3; IQR 1), respectively, but 0 in calves (minimum: 0; maximum: 3; IQR: 1).

In all production groups, most producers used a parasite control product only once per year. There was no statistically significant difference in the frequency of annual treatments between herd sizes (smallest P = 0.2). Sixty-five of 69 producers with ≤ 300 cow-calf pairs used a registered parasite control product in the cows, and 83% (54/65; 95% CI: 72% to 91%) of them used a product only once per year. All 28 producers with > 300 cow-calf pairs used a parasite control product and 82% (23/28; 95% CI: 63% to 94%) used a product only once per year. Similarly, 96% (66/69) of producers with ≤ 300 cow-calf pairs used a registered control product in their replacement heifers, and 85% (56/66; 95% CI: 74% to 92%) used it once per year. Ninety-six percent (27/28) of producers with > 300 cow-calf pairs used a parasite control product in replacement heifers and of those, 81% (22/27; 95% CI: 58% to 91%) used a product once per year. Of the 45 producers who used parasite control products in their calves, 32 owned herds with ≤ 300 cow-calf pairs while 13 had > 300 cow-calf pairs. Ninety-one percent (29/32; 95% CI: 75% to 98%) of small herd producers and 77% (10/13; 95% CI: 46% to 95%) of large herd producers treated their calves once per year.

November was the month in which most cows (45% (43/95); 95% CI: 35% to 56%) and replacement heifers (42% (39/93); 95% CI: 32% to 53%) were treated. For the 45 herds that reported the date of treatment for calves, the pattern of most frequent application was split with 51% each (23/45; 95% CI: 36% to 66%) treating between March to May and between October and December.
For herds that reported the method of application for each animal production type, a topical pour-on was used alone or in combination by 99% (94/95; 95% CI: 94% to 100%), 95% (88/93; 95% CI: 88% to 98%), and 87% (39/45; 95% CI: 73% to 95%) of producers to deworm cows, replacement heifers, and calves, respectively. In-feed or mineral mix administration, alone or in combination, was comparatively rare. Three percent (3/95; 95% CI: 0.7% to 9%) and 1% (1/95; 95% CI: 0.02% to 6%) of producers used an oral drenching product or an in-feed/mineral mix in cows, respectively, while replacement heifers were treated with a drench formulation or in-feed/mineral mix alone or in combination by 17% (16/93; 95% CI: 10% to 26%) of producers. Eighteen percent (8/45; 95% CI: 8% to 32%) of producers used an oral drench or in-feed/mineral mix alone or in combination with a pour-on in their calves. Table 1 shows the months and frequency of oral anthelmintic product administration to cows, replacement heifers, and calves. Injectable was the other route of administration but this was only used by 2 producers to treat calves.

Two classes of parasite control products were utilized: macrocyclic lactones (ML) and benzimidazoles (BZ) (or a combination of the 2). For all animal production types, the most commonly used parasite control product class was an ML in 99% (94/95; 95% CI: 94% to 100%), 95% (88/93; 95% CI: 88% to 98%), and 87% (39/45; 95% CI: 73% to 95%) of cows, replacement heifers, and calves, respectively. All drenches and in-feed/mineral mix products contained BZ as the active ingredient. Overall, 16 herds treated their animals with a BZ product at least once: 10 herds with ≤ 300 head and 6 herds with > 300 head.

When applying parasite control products, 76% (73/96; 95% CI: 66% to 84%) of producers applied visual estimation of the animal's weight to calculate the dose required, while 14% (13/96; 95% CI: 7% to 22%) used a weigh scale. The remaining 10% (10/96; 95% CI: 5% to 18%) used other methods, including estimated weight averages based on records. When herd size was examined, the use of a weigh scale was similar for large herds (14%; 4/28) and small herds (13%; 9/69) (P = 0.9).

**Producer opinion on gastrointestinal nematode management**

Producers were asked about their most important reason for choosing to use a parasite control product. Of the 97 responses, 47% (95% CI: 38% to 58%) stated that their main reason to treat was 'routine herd management practice' (Figure 2). The most important reason for 29% (95% CI: 21% to 39%) of producers was to “control external parasites” and 10% (95% CI: 6% to 18%) indicated they did so on the 'recommendation by their veterinarian'. Although that answer option was available, none of the producers chose to use a product specifically for the “control of internal parasites.”

Veterinarians were the main source of information regarding parasite control product choice for 66% (95% CI: 56% to 75%) of producers. Drug product representatives were the main source for another 20% (19/97; 95% CI: 13% to 29%) and the remaining 14% (14/97; 95% CI: 9% to 23%) reported personal experience or knowledge from literature such as cattlemen's magazines as their primary information sources.

Producers were asked to indicate, on a scale from “very important” to “not important,” how product price, efficacy against internal parasites, efficacy against external parasites and ease of application influenced their product choice. Price was “important” to 68% (66/97; 95% CI: 58% to 77%) of producers, effectiveness in treating internal and external parasites was “very important” for 61% (59/97; 95% CI: 51% to 70%) and 63% (61/97; 95% CI: 53% to 72%), respectively, while ease of application was “important” for 54% (52/97; 95% CI: 43% to 63%).

**Diagnostic monitoring of gastrointestinal nematode infection**

Lastly, producers were asked if fecal egg counts (FEC) had been used in the past 3 y to monitor GIN burden in their cattle. Sixty-seven percent (63/94; 95% CI: 57% to 76%) indicated they had not used FEC in the past 3 y while 3 producers were unsure.

Overall, 33% (31/94; 95% CI: 24% to 43%) of producers had FEC performed. Twenty-four percent (23/94; 95% CI: 16% to 34%) sampled mature cows, 14% (13/94; 95% CI: 8% to 22%) sampled replacement heifers, 4% (4/94; 95% CI: 1% to 11%) sampled steers and 2% (2/94; 95% CI: 0% to 7%) sampled calves. No bulls were sampled.

**Discussion**

The primary objective of this study was to describe current management practices associated with GIN control in western Canadian cow-calf herds.

Mature cattle and replacement heifers were most commonly pastured on a rotational grazing system irrespective of herd size. It has been suggested that intensive rotational grazing systems may result in increased, or at least not reduced, GIN burdens compared to continuous grazing systems as they increase grazing closer to fecal pats and lower down the sward thereby increasing exposure to infective L3 larvae (17,18). Similarly, increased pasture stocking density has been associated with increased GIN infection (1,19). However, many factors including pasture species, rate of pasture regeneration, and frequency of rotation and stocking density influence GIN infection pressures (1,17). While rotational grazing systems were frequently used by producers in this study, for most production sites and production types this was paired with the lowest stocking density from which producers could choose. This could suggest that the risk for acquiring GIN may be lower in western Canadian cow-calf operations; however, it is important to note that defining rotational grazing systems and stocking density is difficult. Although a definition in the context of this questionnaire was supplied, producers may still have based their answers on a subjective understanding of their system or may have had to choose one of the available options even if none reflected their grazing system entirely. Therefore, its interpretation must be viewed with some caution. In terms of stocking density, cattle do not graze pastures at random; in return, fecal deposition and, therefore, the density of L3 larvae on pasture, is not evenly distributed (20). Furthermore, environmental conditions and terrain affect actual stocking density; for example, yearly variations in pasture growth

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because of droughts or flooding may impact the area actually available for grazing (21). Although stocking density was quantified in this study, it left room for individual interpretation. This uncertainty must be recognized when assessing the influence of stocking density on the risk of GIN infection in these herds.

The most striking information to come from producers’ responses to the questionnaire is the almost uniform dependence on the use of a pour-on ML parasite control product in the fall as part of a routine management program. These preferences were not influenced by herd size. The format of the survey allowed producers to only select 1 “most important” reason for treating with a control product and an explanation for why a fall-treatment was a routine management practice was not sought. The second most selected answer was “in order to control external parasites.” Given the predominance of lice infestation in cattle during winter it is likely that the “routine management practice” was mainly to target ectoparasites. Fall application is not only timely for treatment/prevention of ectoparasites, it is also practical because pregnancy diagnoses are usually conducted at this time of the year, minimizing cattle handling. While external parasite control and practicality make a blanket fall-treatment a logical choice, this practice supports the development of GIN resistance and warrants creative solutions to control external parasites. Whole herd fall-treatments were also predominant amongst 14 Saskatchewan beef herds where all but 3 producers applied an ML, and amongst 246 cow-calf producers, mostly from Alberta, where 91% treated cows with an antiparasitic (22,23). Likewise, 97% of questioned Saskatchewan dairy producers also report a predominant use of ML and 73% applied whole herd treatments (24). In 2872 beef herds in 24 US states, pour-on application of MLs was the preferred choice and application was also based on routine fall schedule (25).

Compared to cows and replacement heifers for which most producers used a parasite control product at least once, only approximately half of the producers treated calves, similar to Murray et al (23). Timing of treatment administration varied more in calves compared to cows or heifers. About half of treated calves received the treatment in the early spring, presumably coinciding with pasture turnout. Similar to fall treatments applied to adult cows, spring application to calves is suboptimal for GIN control based on known epidemiology in northern temperate environments and based on the expected low GIN burden in calves at that time of the year (15). Based on results by Mackie et al (26) on beef cows and calves in Ontario, the optimal time to treat calves with a parasite control product would be late June to early July. Moving treatment of calves to this time of the year, however, presents a logistical challenge for producers who rarely handle the herd in the period after turnout.

Several management choices made by surveyed producers have been associated with the development of AR including the potential under-dosing of animals depending on dose calculation method (e.g., visual estimation versus weigh scale), method of application and the blanket treatment of all animals in a herd (6,10,27). The effectiveness of pour-on products has been questioned as they have resulted in under-dosing because of variable drug uptake influenced by weather, cleanliness and coat condition, accuracy of application, and licking behavior of animals (27). All of these practices place increased selection pressures on GIN by reducing the refugia population. Obviously creating one standard guideline for managing GIN in cow-calf herds is impossible because of large variations in locations and management programs. However, some key considerations should be made to help reduce the risk of AR development. Some of these include reducing the risk of under-dosing, targeted treatments or targeted selective treatments (TST), using combinations of anthelmintic drug classes, and monitoring the effectiveness of treatments (10,28). While information on TST of cattle is increasing, ectoparasite control will continue to be important and the life cycle of many ectoparasites warrants treatment and, frequently, re-treatment of all animals in a herd (29,30). Pour-on ML products with an extended effect duration against ectoparasites are an obvious choice for many producers as lice infections are a clearly visible problem. These products are generally also safer for the animal, the environment, and the applicator than many ectoparaticides (31,32). If cow-calf producers were to adopt a “refugia approach” and leave some animals untreated for GIN, it may be necessary for them to choose another product with a narrower range for ectoparasites in those cattle that are exempt from anthelmintic treatment. Besides the concern for AR development in GIN with the current predominant practices, there are rising concerns about ML resistance in bovine ectoparasites (33,34). It is likely that this may ultimately become a stronger motivator for cattle producers to change their current practices than the risk of GIN resistance, particularly for as long as obvious clinical signs resulting from GIN resistance are not apparent.

The results of this survey also highlight that while the use of parasite control products is highly prevalent and effectiveness of treatment against internal (and external) parasites was considered very important by most producers, fecal egg counts were rarely done. Only 32% of producers had a FEC performed in the last 3 y. The use of FEC and FEC reduction tests to monitor treatment effectiveness or to identify the need for treatment are important strategies to try to recognize AR development in herds as early as possible (35).

While herd recruitment was directly aimed at creating a representative sample of western Canadian operations, ultimately there is some degree of selection bias based on producers’ motivations for participation. A 93% response rate is excellent for a questionnaire and non-response bias is unlikely to have significantly influenced the results here. Recall bias may be another source of misinformation; the questionnaire asked producers to recall herd management for the previous (2015) grazing season; it is possible that not all producers accurately remembered the requested information. Therefore, as with all voluntary response questionnaires, there are some risks in applying the results to the wider population of beef cow-calf producers. Nonetheless, the responses obtained here represent a current source of information that may be used to guide future research in western Canada, including systematic evaluation of risk factors and assessing the levels of AR in these herds.
References


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Muscle tears as a primary cause of lameness in horses: 14 cases (2009–2016)

Thomas E. Cullen, Stacy A. Semevolos, Susanne M. Stieger-Vanegas, Katja Duesterdieck-Zellmer

Abstract — This study describes clinical and ultrasonographic findings and outcomes of horses with lameness associated with muscle tears. Records of horses diagnosed with muscle tears were retrospectively evaluated. Horses in which one or more muscle tears were confirmed ultrasonographically and lameness was associated with the tear were included in the study (n = 14). Eight horses had tearing of a single muscle, 6 horses had 2 or more muscles involved. Twelve of 14 horses survived to discharge and were alive at follow-up (8 to 90 months). Recovery time ranged from 6 to 52 weeks (mean: 19.8 weeks); 6 to 16 weeks for single muscle injuries and 12 to 52 weeks for multiple muscle injuries. Of the 12 long-term survivors 3 had chronic lameness/stiffness preventing return to their previous activity level and 9 returned to equal or greater level of activity. No statistically significant difference existed between outcomes and location of injury or number of muscles injured.

Key clinical message:
This study indicates that conservative management of muscle tears can result in favorable long-term outcomes.

La présente étude décrit les trouvailles cliniques et échographiques ainsi que le devenir de chevaux avec une boiterie associée à des déchirures musculaires. Les dossiers de chevaux diagnostiqués avec une déchirure musculaire furent rétrospectivement examinés. Les chevaux chez qui une ou plusieurs déchirures musculaires furent confirmées par échographie et dont la boiterie était associée avec la déchirure furent inclus dans l'étude (n = 14). Huit chevaux avaient une déchirure de seulement un muscle, 6 chevaux avaient 2 muscles ou plus d’impliqués. Douze des 14 chevaux ont survécu jusqu'au congé et étaient vivants lors du suivi (8 à 90 mois). Le temps de guérison varia de 6 à 52 semaines (moyenne : 19,8 semaines); 6 à 16 semaines pour une blessure à seulement un muscle et 12 à 52 semaines pour des blessures musculaires multiples. Parmi les 12 survivants à long-terme, trois avaient une boiterie chronique/raideur empêchant un retour à leur niveau d’activité antérieur et neuf retournèrent à un niveau d’activité égal ou plus grand. Aucune différence statistiquement significative n’existait entre le devenir des chevaux et la localisation de la blessure ou le nombre de muscles blessés.

Message clinique clé :
Cette étude démontre qu’une gestion conservatrice des déchirures musculaires peut résulter en une issu favorable à long terme.


Muscle injuries due to overuse or direct trauma result from contusion (heavy compression injuries), strain (excessive tensile forces), or tears (fiber transection) within the muscle (1). Classification of muscle injuries generally reflects the degree of functional or structural muscle damage due to fiber disruption within the muscle body or musculotendinous junction (2–4). A consensus statement for classification of human athlete muscle injuries was published in 2013 (2). In this classification system, type 1 and type 2 injuries relate to functional muscle disorders, while type 3 and type 4 injuries include structural tears in the muscle.

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Ultrasonography and magnetic resonance imaging (MRI) are the most used imaging modalities for diagnosing muscle strain/tear injuries in horses, dogs, and human athletes (5–9). In horses, ultrasonography provides the most practical diagnostic option, as it is relatively inexpensive and available to most practitioners. Additionally, ultrasonographic evaluation provides a real-time anatomic and functional assessment, revealing disruption of normal muscle fiber architecture, alteration in size or shape of the muscle and variable areas of echogenicity. In contrast, MRI of upper limb muscles is not widely available, is limited by MRI gantry dimensions and size of the patient, typically requires general anesthesia, and is expensive. Ultrasonography is also a relatively easy and cost-effective method of achieving good linear follow-up with these types of cases.

Muscle tears involving true disruption to fibers within the body of the muscle are not widely reported as a cause of lameness in veterinary medicine (5,10), most of our understanding comes from human studies (1–4,11). Of the reports in horses, most describe hind limb muscle injuries (5,12–16,17), including rupture of the gastrocnemius (12–15) and fibularis tertius (formerly peroneus tertius) muscles (16). Only a few single case reports describe forelimb muscle injury (18,19). More studies are needed to assess clinical findings and outcome following muscle tears in horses, particularly for forelimb injuries.

The objective of this retrospective study, therefore, was to describe clinical and ultrasonographic findings and provide outcomes for horses having lameness due to forelimb and hind limb muscle tears. We hypothesized that outcomes would be similar for forelimb and hind limb muscle tears, and that horses having a single muscle injury would have more favorable outcomes than horses with multiple muscles injured.

**Materials and methods**

**Case selection criteria**

Medical records were reviewed for horses that were presented to the Oregon State University Veterinary Teaching Hospital from 2009 to 2016 with lameness and tearing of ≥ 1 muscle. Records were reviewed retrospectively at the time of image evaluation for this study. For inclusion in the study, horses were required to have clinical evidence of tearing (either acute or chronic) of single or multiple muscles resulting in lameness, as well as ultrasonographic confirmation of muscle tearing.

**Medical records review**

Data obtained from medical records included the patient’s signalment, history related to the injury, physical examination findings, ultrasonographic findings, work discipline or use prior to injury, treatment, and outcome. The lameness grade at presentation to the hospital was also noted [American Association of Equine Practitioner’s (AAEP) scale] (20). Clinical evidence of muscle tearing was defined as either finding of lameness at presentation, focal swelling of single or multiple muscles, sensitivity to palpation of affected musculature, and/or a history of trauma.

Ultrasonographic examination was performed after the hair was clipped and the skin cleaned and wiped with 70% isopropyl alcohol. Ultrasound coupling gel was used in cases in which skin-probe contact was poor. Acquisition of ultrasonographic images for superficial injuries was performed with a variable frequency (8 to 12 MHz) linear transducer. For injuries deeper than 8 cm a variable frequency (2 to 5 MHz) curvilinear transducer was used. Ultrasonographic images were acquired in both cross-section and longitudinal planes, and in cases in which interpretation of the images was ambiguous, comparison with the contralateral limb was also performed. Comparative images of the contralateral limb were available for review in 5/14 cases. Ultrasonographic images were evaluated retrospectively by a Board-certified radiologist in order to confirm the clinical diagnosis and to grade the muscle injuries as either partial tears or complete ruptures of the muscles involved. Images were assessed for variations in echogenicity, presence of fluid consistent with hematoma formation, muscle fiber pattern disruption, fascial injury, and altered muscle size. The origin and insertion of the muscles (musculotendinous junction) were carefully evaluated when possible. Subjective evaluation of the static images and qualitative descriptions of the injuries were completed, and in all cases, the retrospective imaging findings agreed with the clinical assessment of the injuries at the time of presentation as recorded. Classification of muscle tears based on clinical and imaging findings, as has previously been described in humans, was not possible due to the retrospective nature of the study and the availability of only static images (2–4).

Other potential causes of lameness in affected horses were ruled out using a combination of diagnostic techniques. Localizing the region of injury was uncomplicated in all cases, due to signs such as sensitivity to palpation, limb swelling, or external wounds. Where appropriate, radiographs of areas on the affected limbs localized to regions of pain on palpation or visible soft tissue swelling were acquired to rule out any potential underlying fractures or acute osseous injuries. Scintigraphy was performed in a single case in which there was concern for a potential underlying pelvic fracture.

Follow-up information regarding the injuries and outcome was obtained via re-check evaluations and/or telephone conversations with the owners and referring veterinarians. The outcome was deemed as favorable in those horses that returned to the same or greater level of activity as they had prior to injury. Statistical significance for frequency comparisons (forelimb versus hind limb, multiple versus single muscle injuries, horses < 4 y old versus horses ≥ 4 y old) among those horses that returned to an equal or greater level of athletic activity and those that did not was evaluated using the Fisher’s exact test ($P \leq 0.05$).

**Results**

**Signalment and history**

Muscle tear injuries were diagnosed in 14 horses, including 4 Quarter Horses, 2 Thoroughbreds, 2 Arabians, 2 Warmbloods, 1 Irish Draught, 1 Irish Sport Horse, 1 Morgan, and 1 Paint. There were 6 females, 6 geldings, and 2 intact males. Ages ranged from 8 mo to 23 y old (median: 10 y old). Eleven horses had a history of trauma, including 4 that sustained the injury after falling. Three horses were found lame in their stall with no history of trauma.
Table 1. Summary of outcomes following muscle injuries in horses including age, location of injury (forelimb or hind limb), number of muscles affected, lameness grade at presentation, muscle enzyme concentrations, time between injury and presentation, and work discipline prior to injury.

<table>
<thead>
<tr>
<th>Case</th>
<th>Forelimb or hind limb</th>
<th>Single or multiple muscles affected</th>
<th>Lameness grade at presentation (AAEP scale)</th>
<th>CK (U/L) within 24 h of admission [reference range: 145 to 633 U/L]</th>
<th>AST (U/L) within 24 h of admission [reference range: 212 to 453 U/L]</th>
<th>Outcome favorable/unfavorable</th>
<th>Age</th>
<th>Discipline before injury</th>
<th>Time from injury to presentation (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Forelimb</td>
<td>Single</td>
<td>4/5</td>
<td>115</td>
<td>857</td>
<td>Favorable</td>
<td>12 y</td>
<td>Pleasure riding</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>Forelimb</td>
<td>Single</td>
<td>4/5</td>
<td>8003</td>
<td>1234</td>
<td>Favorable</td>
<td>8 mo</td>
<td>Unbroken</td>
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<td>Single</td>
<td>2/5</td>
<td>N/A</td>
<td>N/A</td>
<td>Favorable</td>
<td>8 y</td>
<td>Pleasure riding</td>
<td>35</td>
</tr>
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<td>4</td>
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<td>Single</td>
<td>4/5</td>
<td>271</td>
<td>295</td>
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<td>23 y</td>
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<td>5</td>
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<td>4/5</td>
<td>5316</td>
<td>490</td>
<td>Favorable</td>
<td>4 y</td>
<td>Barrel horse</td>
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<td>6</td>
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<td>N/A</td>
<td>345</td>
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<td>5/5</td>
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<td>586</td>
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<tr>
<td>8</td>
<td>Forelimb</td>
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<td>2/5</td>
<td>179</td>
<td>363</td>
<td>Unfavorable</td>
<td>4 y</td>
<td>Barely ridden</td>
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<td>9</td>
<td>Hind limb</td>
<td>Single</td>
<td>4/5</td>
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<td>214</td>
<td>Favorable</td>
<td>17 y</td>
<td>Jumper</td>
<td>14</td>
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<td>339</td>
<td>Favorable</td>
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<td>Hind limb</td>
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<td>Unfavorable</td>
<td>9 y</td>
<td>Pleasure riding</td>
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<td>11 y</td>
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<td>680</td>
<td>Unfavorable</td>
<td>9 y</td>
<td>Pleasure riding</td>
<td>3</td>
</tr>
</tbody>
</table>

AAEP — American Association of Equine Practitioners; CK — Creatine kinase; AST — Aspartate aminotransferase; N/A — Not applicable.

Physical examination and lameness findings

All horses had palpable swelling at the site of muscle tearing. Sensitivity to palpation or manipulation of the affected region was observed in 9/14 cases, those without sensitivity were the milder single muscle injuries and more chronic cases presenting more than 1 wk after injury. All horses presented with lameness on arrival at the hospital, ranging from grade 2/5 to 5/5 (AAEP scale) (Table 1) (20). Time between onset of lameness and presentation to the hospital ranged from 6 h to 6 wk (mean: 8.7 d). Only 2 horses were presented with a lameness grade of less than grade 4/5, both of which had an interval of 5 wk or more from onset of clinical signs to presentation. Eight cases involved a single muscle and 6 cases involved 2 or more muscles (Table 1).

Serum biochemistry

Muscle enzyme concentrations were evaluated at presentation in 10/14 cases, including creatine kinase (CK) in 9 horses and aspartate aminotransferase (AST) in 10 horses (Table 1). Creatine kinase concentration was increased above the reference in 5/9 cases [mean: 2523 U/L; range: 1073 to 8003 U/L; reference interval (RI): 145 to 633 U/L]. Aspartate aminotransferase concentration was increased above the reference range in 5/10 horses (mean: 540 U/L; range: 214 to 1234 U/L; RI: 212 to 453 U/L).

Diagnostic imaging findings

Disruption of the normal muscle fiber pattern and the associated fascia was identified on review of the ultrasound images in all 14 cases. Intramuscular fluid accumulation suggestive of hematoma formation (Figure 1) was diagnosed with ultrasonography in 11/14 horses (10 of these were presented within 2 wk of the onset of clinical signs). In a single case of semimembranosus muscle injury, fluid (most likely circumferential hematoma formation) with mild retraction of the muscle was noted around the entire muscle belly, separating it from the surrounding musculature (Figure 2). Affected forelimb muscles included: cleidobrachialis (n = 3) (Figure 3), triceps (n = 2), and 1 each for deltoideus, biceps brachii, extensor carpi radialis, subclavius, superficial digital flexor, ulnaris lateralis, and flexor carpi ulnaris. Hind limb injuries affected the: semimembranosus (n = 3), semitendinosus (n = 1), gracilis (n = 1), fibularis tertius (n = 1), gluteus (n = 1), and adductor (n = 1) muscles. In cases with injuries to multiple muscles, the groupings of muscles injured were as follows: ulnaris lateralis and flexor carpi ulnaris (n = 1); semimembranosus, and semitendinosus (n = 1); superficial digital flexor and triceps (n = 1); adductor, semimembranosus, and gracilis (n = 1); subclavius and cleidobrachialis (n = 1); biceps brachii and extensor carpi radialis (n = 1). Follow-up ultrasound images were available for review in 4/14 cases. Time of follow-up ranged from 1 to 6 wk. In all follow-up images there was reorganization and remodeling of the hematomas compared with the initial ultrasound evaluation. Disruption of the muscle fiber pattern remained evident in all follow-up images.

Radiographs were taken in 8 cases. Radiographs were acquired due to the significant degree of lameness and swelling associated with the injuries. Radiographs excluded any potential significant underlying osseous pathology, 2 cases possessed mild changes associated with osteoarthritis which was not deemed significant enough to contribute to the emergent problem. Nuclear scintigraphy was performed in 1 case of gluteal muscle injury to rule out any associated pelvic fractures. No significant abnormality was detected.

Treatment

All horses, aside from a single horse which was euthanized at the time of presentation, underwent a period of stall confinement ranging from 1 wk to 12 wk (mean = 4.2 wk) followed by a gradual return to exercise. The typical rehabilitation program...
consisted of 5 to 10 min of controlled exercise (i.e., hand walking) twice daily, then increasing by 5 min per wk until a subsequent reassessment to determine suitability for return to light ridden exercise. This program was fairly standard across all the horses that underwent rehabilitation. Owners were also instructed on how to perform passive mobilization in cases for which clinicians were concerned about potential restriction to range of motion due to scar tissue formation. Non-steroidal anti-inflammatory drugs (NSAIDs) were used in all cases at the time of hospital admission and as part of the treatment protocol at home for 11/14 cases. The most common protocol was treatment with daily NSAIDs during hospitalization and for a period of 5 to 7 d following discharge from the hospital. The NSAIDs included phenylbutazone (Phenylbutazone; Vet One, Boise, Idaho, USA), 2.2 mg/kg body weight BW, IV (n = 7), flunixin meglumine (Banamine; Merck Animal Health, Madison, New Jersey, USA), 1.1 mg/kg BW, IV (n = 4), firocoxib (Previcox; Merial, Duluth, Georgia, USA), 0.1 mg/kg BW, PO (n = 1) and topical diclofenac (Surpass; Boehringer Ingelheim, St. Joseph, Missouri, USA) (n = 1). Additional treatments included antibiotics (n = 5) and dimethyl sulfoxide (DMSO; FWI, Tulsa, Oklahoma, USA), 0.5 g/kg BW, IV (n = 3). Antibiotics were used in the cases that involved open skin wounds. While in hospital 2 horses received Procaine Penicillin G (VetriPen G; Vet One), 22 000 units/kg BW, IM, combined with gentamicin sulphate (GentaFuse; Henry Schein, Lenexa, Kansas, USA), 6.6 mg/kg BW, IV; 2 horses received sulfamethoxazole and trimethoprim (SMZ; Amneal Pharmaceuticals, Glasgow, Kentucky, USA), 30 mg/kg BW, PO; and 1 horse received enrofloxacin (Baytril; Bayer, Shawnee Mission, Kansas, USA), 5.5 mg/kg BW, IV. Two horses were discharged on sulfamethoxazole and trimethoprim, 30 mg/kg BW, PO for 2 wk until reassessment of the muscle injury and associated wounds. Adjunctive therapies included: chiropractic adjustment (n = 4), thermal therapy (n = 3), acupuncture (n = 3), therapeutic ultrasound (n = 1), and low-level laser therapy (n = 1).

Outcome

Most horses (13/14) survived to discharge; 1 was euthanized on presentation due to the severity of the injury (Table 1, Case 14). Follow-up data were available in all remaining cases. One horse was euthanized 2 wk after discharge (Table 1, Case 7) due to worsening of contralateral support limb laminitis that had started while hospitalized. Another horse was euthanized approximately 1 y after discharge (Table 1, Case 11) for reasons unrelated to the muscle injury; however, it had not returned to its previous level of activity after injury. The remaining 11 horses were alive at the time of follow-up, between 8 and 90 mo after injury.

Recovery time was defined as the time taken by the patient to return to its previous level of work or the time beyond which the owners detected no further notable improvement. Recovery times ranged from 6 wk to 52 wk (mean: 20 wk). All horses which had injury to a single muscle were reported to have recovery times of 6 wk to 16 wk (median = 12 wk). Horses with injuries to multiple muscles had reported recovery times of between 12 wk and 52 wk (median = 42 wk).
Nine of the 14 horses had favorable outcomes, returning to an equal or greater level of activity following injury (Table 1). The remaining 5 horses had unfavorable outcomes; 3 of these had chronic lameness or stiffness that prevented them from returning to the same level of activity as they had prior to injury. The 3 chronic cases involved tears to the gluteus (n = 1), fibularis tertius (n = 1), subclavius and cleidobrachialis (n = 1). In all 3 of these cases the owners had elected not to have any additional diagnostic tests to further investigate the residual lameness or stiffness.

Outcomes between forelimb and hind limb muscle injuries were not significantly different (P = 0.58). Outcomes between single muscle and multiple muscle injuries were not significantly different (P = 0.58). Outcomes between horses ≤ 4 y old and horses > 4 y old were not significantly different (P = 1.00). No differences were found in outcomes for horses having elevated serum concentrations of CK (P = 1.00) or AST (P = 1.00) compared to horses with normal muscle enzyme concentrations.

### Discussion

Conservative management of muscle injuries resulted in favorable long-term outcomes in 9 of 14 horses. In support of our hypothesis, there was no difference in long-term outcomes between forelimb and hind limb muscle injuries. Contrary to our hypothesis, having single versus multiple muscles injured did not affect overall outcome. However, the outcome for single muscle injuries was better for forelimbs than hind limbs, although these results may reflect the low statistical power of the study. In addition, recovery times were generally shorter for single muscle injuries (< 4 mo) than multiple muscle injuries (up to 12 mo). This difference in recovery times is likely due to the injuries involving multiple muscles being more complex than those involving just a single muscle with potential for increased scar tissue formation and long-term restriction to range of motion.

Our hypothesis that horses with elevated serum muscle enzyme concentrations would have less favorable outcomes was not supported by this study; however, the results were based on a small number of horses. The inconsistencies related to muscle enzyme concentrations were possibly due to the variability in the severity of the presenting injuries and also the highly variable times between injury and presentation to the hospital.

High performance equine athletes are at risk of developing muscle injuries, based on inferences from human studies (21). However, over a 7-year period, our study identified a low number of cases, and a previous study also reported a low incidence of muscle rupture cases out of all equine necropsies having muscle pathology (22). Unlike muscle injuries in humans, most cases identified for inclusion in our study were traumatic and not athletic injuries. The population in this study is reflective of a referral institution, and it is therefore likely that many milder muscle injuries were treated in the field by first opinion practitioners. In addition, necropsies are less commonly performed on horses outside a hospital environment, further decreasing the identification rate of muscular injuries. Taking the limitations of this study into account, we theorize that the true incidence of muscle injuries may be higher because milder injuries are less likely to be definitively diagnosed and reported.

Clinical diagnosis of muscle injuries in horses depends mainly on physical examination findings, with muscle swelling,
sensitivity to palpation, and lameness being suggestive of muscle injury. Diagnosis of muscle injuries can be challenging, and although it was not recorded in any of the cases in this study, clinical signs at presentation can sometimes mimic those often seen with cases of colic (23). All cases included in our study were presented to the hospital for assessment of a lameness with the most frequent grade of lameness at presentation being a grade 4/5 (n = 11). This degree of lameness is frequently attributed to injuries such as fractures, intrasynovial sepsis, laminitis, subsolar abscession, or other periarticular infections (23). During the time period of the study, the number of muscle injury cases was relatively low, but it may be worth considering that when seeing a case with a grade 4/5 lameness, muscle injury may warrant addition to the list of differential diagnoses. In addition, ultrasonographic evaluation is necessary for definitive diagnosis. However, the original examinations were performed by clinicians with limited ultrasonography experience, who found it challenging to identify the muscle injuries in 7 horses. In these cases, having an experienced ultrasonographer (Board-certified radiologist) was critical in locating areas of muscle injury.

On ultrasound images, normal muscle fibers are hypoechoic with small hypechoic speckles or lines representing the perimysium surrounding the muscle fibers (6). Intramuscular septae, if present, are seen as hypechoic lines often creating a reticular pattern in the muscle bundles. An outer fascial sheath (epimysium) surrounds all muscle bundles and is smooth, thin, and hypechoic on ultrasound images. In an acute muscle injury due to strain, tear, or contusion, the severity and extent of the ultrasonographic findings vary depending on the extent of muscle injury. With a mild injury, the muscle can appear ultrasonographically normal or have a focal or diffuse area of increased echogenicity with areas of fluid adjacent to the fasciae. With increasing muscle injury severity, the sonographic changes will include disruption of the muscle fibers, loss of visualization of the perimysium, with or without intramuscular fluid accumulation. Additionally, detachment of the muscle from adjacent fasciae or bone attachment (aponeurosis) can be noted. In severe cases, complete rupture of the musculotendinous junction or avulsion of the bone attachment can be found.

In our cases, we saw a wide range of muscle injuries, most of which were strains resulting in partial detachment of muscles from the adjacent fascia. Only 1 of our cases had complete myotendinous junction rupture. In the case with injury to the fibularis tertius muscle, the injury was at the level of the mid body of the muscle, with significant disruption of the muscle fibers, but not complete rupture. This meant that the reciprocal apparatus remained functional and prevented extension of both the hock and stifle simultaneously, which is classically seen in cases of complete fibularis tertius rupture (16). Unfortunately, due to the retrospective nature of this study, accurate grading of muscle injuries was not possible as dynamic assessment of muscle injury in real time would have been needed.

Current therapies for muscle injuries are mainly based on empirical evidence with a lack of prospective randomized trials (10,24,25). The immediate post-injury treatment protocols used in human athletes typically follow what is referred to as the “PRICE” protocol (protection, rest, ice, compression, and elevation) and are designed to try and reduce hemorrhage at the site of injury and subsequent scar tissue formation (24). In human athletes an initial period of immobilization is recommended to prevent stretching and further injury of the affected muscles (24). Achieving elevation of muscles in equine patients is not possible as it would require the horse to unweight the affected limb for a period of time. Protection or immobilization of injured muscles is difficult in the equine athlete with external coaptation only practicable for lower limb muscles. Firm adhesive taping in the absence of any other support is commonly used on human athletes, generally results in adequate immobilization (1,24), and could be useful in cases of equine muscle injury. Rest in the immediate post-injury period and ice therapy are practical treatment options for equine patients and are used regularly by many practitioners where appropriate. Within 3 to 7 d of injury human athletes will often have passive and active range of motion exercises included in their rehabilitation protocol. This early return of motion has been shown to significantly improve both the recovery time and the quality of healing that occurs in the muscle tissue (1,26). There may be a tendency in equine practice to have greater periods of rest following injury; however, if the patient is doing well, faster introduction of physiotherapy and range of motion exercises may be warranted and could improve outcomes.

Stall confinement was included as part of the treatment protocol for all of our cases in which treatment was attempted, with large variability between individual cases for the duration of rest period prescribed. Treatment recommendation for dogs and human athletes is an initial period of immobilization in the acute injury phase, followed by mobilization of the injured muscle(s) to limit atrophy of the healthy muscle fibers and deposition of excessive connective tissue (1,10,26,27). The initial rest period allows the granulation tissue to develop sufficient tensile strength to withstand the distraction forces applied to it during active muscle contraction (1). Mobilization after a short period of rest results in more rapid hematoma resolution, reduction of inflammatory mediators, greater myofiber regeneration, and earlier increase in tensile strength and stiffness (26). Conversely, too early a return to exercise can interfere with reorganization of myofibers, potentially increasing the amount of scar tissue formed at the site of injury and also the risk of reinjury (1). All cases herein received some passive or controlled exercise during the recovery period.

In horses, adjunctive therapies such as extracorporeal shock wave, low level laser therapy, therapeutic ultrasound, or regenerative medicine, may also be considered in the treatment of primary muscle injuries. Extracorporeal shock wave therapy is a therapy used for treatment of tendon and ligament injuries in horses (28) but its applications may also extend to muscle injuries (29). Low level laser therapy has been used; however, its effectiveness for treatment of deeper muscle injuries in horses may be limited, due to the inability of laser light to permeate deeper tissue layers at a sufficient therapeutic level (30). Therapeutic ultrasound is another adjunctive therapy that has been used for the treatment of muscle injuries, exerting both thermal and non-thermal effects (31), potentially improving scar quality (32). Regenerative therapies such as platelet-rich plasma...
(PRP) and stem cells may also be useful in the treatment of muscle injuries where there is a true fiber disruption. Both PRP and stem cell therapy have been used extensively for treatment of other types of musculoskeletal injuries in horses (33). There is limited clinical evidence regarding these types of therapies in skeletal muscle injuries, and they are based mainly on human studies (34,35). In our study, adjunctive therapies were used sporadically due to financial or geographic constraints. More cases are needed to establish outcomes following adjunctive therapies of muscle injuries in horses.

The percentage of favorable outcomes of horses in our study (64%) was slightly lower than in previous studies (75% to 85%) (5,14,16,17). This may be due to differences in injury location, severity of injury, or in the calculation of outcome percentages. When only long-term survivors were assessed in our study, a similar proportion (9/12) of horses had favorable outcomes compared to other studies. Unfavorable outcomes were generally related to chronic lameness, laminitis in the opposite limb, or severity of original injury.

This retrospective study identified a diverse series of muscle injuries in a small number of cases, making direct comparisons between cases difficult. Because milder muscle injuries can appear normal on ultrasound images, this study selected for cases difficult. Because milder muscle injuries can appear normal on ultrasound images, this study selected for similar proportion (9/12) of horses had favorable outcomes (5,14,16,17). This may be due to differences in injury location, severity of original injury.

In conclusion, conservative management of muscle injuries can result in favorable long-term outcomes. More cases are needed to determine the effect of treatment factors, such as the length of stall confinement, anti-inflammatory medications, and use of adjunctive therapies on healing of skeletal muscle injury and return to previous activity.

References

Risk and characteristics of gastric carcinoma in the chow chow dog

Amy M. Koterbay, Sureshkumar Muthupalani, James G. Fox, Elizabeth A. McNiel

Abstract — Gastric carcinoma is not commonly reported in dogs. There is an increased risk, however, in certain breeds such as the Belgian Tervuren. Review of the Veterinary Medical Database (VMDB) established an increase in risk for gastric carcinoma in the chow chow breed. In 106 chow chow dogs signs commenced, on average, 3 weeks before definitive diagnosis. The most common clinical signs were vomiting, loss of appetite, diarrhea, and melena. Most affected dogs were euthanized, without treatment, within 2 weeks of diagnosis. Two dogs which were treated aggressively (surgery and chemotherapy) survived a considerably longer time (12 and 36 months). Histologically, these chow chow dogs comprised a similar histologic type as familial gastric carcinoma in humans; diffuse-type carcinoma that was enriched in the signet ring and mucinous variants. Understanding the pathogenesis of diffuse gastric carcinoma in the chow chow dog may provide insight into the biology of this aggressive cancer in humans.

Résumé — Risques et caractéristiques d’un carcinome gastrique chez le chien de race chow-chow. Le carcinome gastrique n’est pas rapporté fréquemment chez les chiens. Il y a toutefois une augmentation du risque chez certaines espèces telle que le Tervuren belge. Une revue de la base de données Veterinary Medical Database (VMDB) a établi une augmentation dans le risque pour le carcinome gastrique chez la race chow chow. Chez 106 chiens chow chow les signes débutèrent, en moyenne, 3 semaines avant le diagnostic définitif. Les signes cliniques les plus fréquents étaient vomissement, perte d’appétit, diarrhée et méléna. La plupart des chiens affectés furent euthanasiés, sans traitement, à l’intérieur de 2 semaines du diagnostic. Deux chiens furent traités de manière agressive (chirurgie et chimiothérapie) ont survécu beaucoup plus longtemps (12 et 36 mois). Histologiquement, ces chiens chow chow comprennent un type histologique similaire aux carcinomes gastrique familiaux chez les humains; le carcinome de type-diffus qui s’est développé dans les variants de cellules en bague à chatons et mucineux. Comprendre la pathogénie du carcinome gastrique diffus chez le chien chow chow pourrait fournir des informations sur la biologie de ce cancer agressif chez l’humain.

(Traduit par Dr Serge Messier)

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Introduction

While gastric cancer in humans is among the leading causes of cancer death worldwide, gastric cancer is uncommon in the dog, accounting for less than 1% of neoplastic diagnoses (1–5). Most canine gastric tumors have been identified as gastric carcinomas but other, less common tumors (listed in order of most frequently reported), include lymphosarcoma, mast cell tumor, leiomyosarcoma, leiomyoma, extramedullary plasmacytoma, gastrointestinal stromal tumor (GIST), and fibrosarcoma (6–12). Despite its reported infrequency in the canine population in general, several breeds have been reported to have a higher incidence of gastric carcinoma including the Belgian shepherd (Groenendeal and Tervuren), Dutch shepherd, Norwegian lundehund, Bouvier des Flandres, collie, and standard poodle (3,13–15). There are also case reports of gastric cancer in association with Ménétrier’s disease in a West Highland white terrier (16) and a family of cairn terriers (17). The high incidence in these specific breeds suggests a hereditary component to canine gastric carcinoma in the dog. However, most clinical or histologic descriptions of dogs with gastric...
carcinoma include relatively small numbers of animals from which it can be difficult to establish a clinical phenotype and investigate the pathogenesis of the disease.

The first report suggesting a predisposition in the chow chow breed described ultrasonographic findings consistent with gastric cancer in 16 dogs, 4 of which were chow chow (18). Other reports in the United States and Europe have also supported the authors’ hypothesis (18,19). Given the poor prognosis for most dogs with gastric carcinoma, understanding the breed-associated pathogenesis could lead to prevention strategies, techniques for early diagnosis, and more effective treatment. In an effort to describe gastric carcinoma in this breed, the aims of the study were to determine the risk ratio for this disease in dogs in North America and then establish a canine gastric cancer tissue repository and database to permit the clinical and histologic characterization of the disease.

Materials and methods
Risk of gastric carcinoma
The veterinary medicine database (VMDB) established in 1964 is a resource that contains coded medical record data from North American veterinary schools (20). Initially, to determine the relative frequency of gastric carcinoma in various canine breeds, data were obtained from the VMDB for the 21-year period between January 1, 1983 and December 31, 2003. The frequency of the gastric carcinoma diagnosis for each breed was compared to the frequency of gastric carcinoma in all dogs and the risk ratio was determined for these breeds. Once an increased risk was identified in the chow chow breed a more extensive search was performed to target the prevalence of gastric carcinoma in the chow chow breed within this time period. For this search, the total number of chow chow dogs, the number of dogs diagnosed with gastric carcinoma, and the number of chow chow dogs diagnosed with gastric carcinoma were investigated.

Evaluation of clinical phenotype
A canine gastric cancer database and repository was established by one of the authors to permit the study of canine gastric carcinoma which couples basic clinical data (age, gender, breed, clinical signs, survival time, diagnosis, and method of diagnosis) with biologic specimens. This repository searched for dogs which were included if they were American Kennel Club (AKC) registered chow chow dogs with a diagnosis of gastric carcinoma and were entered in the database before April 1, 2010. A total of 106 cases fit these criteria. Information abstracted from repository records included gender, age at diagnosis, presenting clinical signs, duration of clinical signs, age at death, location of tumor, and method of diagnosis and treatment. In cases of incomplete data, additional information was gathered by contacting the managing veterinarian and/or the owner when possible. Continuous numerical variables were tested for normality using the Kolmogorov-Smirnov test. If the reported variable did not deviate significantly from a normal distribution, then it was described using mean ± standard deviation (SD). For variables that were not normally distributed, median and range were reported.

A cohort of chow chow dogs collected as controls for the repository were used to compare gender distribution between affected and unaffected dogs. Control dogs were AKC registered chow chow dogs that had no clinical signs of gastric carcinoma, regardless of gender. Clinical signs included vomiting, diarrhea, lethargy, inappetence, and melena. The distribution of male versus female and sexually intact versus altered dogs were compared between animals affected and unaffected by gastric cancer using a Fisher’s exact test with significance set at $P < 0.05$.

Histologic classification
The Lauren (21) and the World Health Organization (22) classification schemes were used to classify hematoxylin and eosin (H&E) stained sections. While all dogs included in the clinical evaluation had a histopathologic diagnosis of gastric carcinoma, the tumors were not systematically classified. Tissue from the repository was reviewed for 18 chow chow dogs; 10 additional previously diagnosed gastric carcinomas from dogs of other breeds were reviewed solely for histologic comparison to the chow chow dogs.

Results
Risk of gastric carcinoma in dogs in North America
To determine the risk of gastric carcinomas within the period from 1983 through 2003, available coded medical records for 932,172 dogs were reviewed through the Veterinary Medicine Database (VMDB). A search of these data identified 568 cases diagnosed with gastric carcinoma (prevalence = 0.06%). One hundred and three gastric carcinoma cases occurred in mixed breed dogs and the rest ($n = 465$) occurred in purebred dogs representing 77 breeds. There was a small, statistically significant, increase in the odds for gastric carcinoma diagnosis in a purebred dog relative to a mixed breed dog (OR = 1.37; 95% CI: 1.11% to 1.69%). Further analysis was performed for breeds in which at least 5 individuals were diagnosed with gastric carcinoma. The frequencies of occurrence and ORs for the diagnosis of gastric carcinoma for the 28 breed classifications meeting this criterion are summarized in Table 1. These data indicate that 3 breeds, including the American cocker spaniel, German shepherd, and the Labrador retriever, as well as dogs designated as mixed breed had a statistically significant decreased risk for developing gastric carcinoma. However, 12 breeds including the chow chow, which is the focus of this paper, had statistically significant increased odds for the diagnosis of gastric carcinoma with ORs ranging between 2.4 and 14. The highest OR was in the chow chow breed.

To determine whether there has been any change in the diagnosis of gastric carcinoma over time, we searched the VMDB for 3 different time intervals namely 1964 (the start of the database) through 1979, 1980 through 1989, and 1990 through 1999. For each time interval, data were available for 524,210 (1964 to 1979), 559,115 (1980 to 1989), and 420,257 (1990 to 1999) individual dogs. The number of dogs classified as chow chow for the same time periods were 995 (1964 to 1979), 4175 (1980 to 1989), and 3913 (1990 to 1999). The frequency of gastric cancer diagnosis in the dog population and in the chow chow population, as well as the OR for the diagnosis in chow chow dogs are shown in Table 2. The prevalence of gastric
ARTICLE

The prevalence of canine gastric cancer diagnosis over time.

<table>
<thead>
<tr>
<th>Time period</th>
<th>Prevalence of gastric cancer diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In all dogs</td>
</tr>
<tr>
<td>1964 to 1979</td>
<td>0.02%</td>
</tr>
<tr>
<td>1980 to 1989</td>
<td>0.05%</td>
</tr>
<tr>
<td>1990 to 1999</td>
<td>0.00%</td>
</tr>
</tbody>
</table>

*Statistically significant increase in risk.*

The VMDB database was searched to identify dogs with a diagnosis of gastric cancer. The frequency of gastric cancer was computed by dividing the number of individual dogs with a gastric carcinoma diagnosis by the total number of individuals in the time period indicated. The frequency and OR (odds ratio) were also calculated for chow chow dogs.

The prevalence of canine gastric cancer increased 3-fold in all dogs between the earliest and the more recent time periods. During the same time periods the prevalence of gastric cancer in the chow chow breed increased nearly 10-fold.

**Clinical characteristics**

One hundred and six chow chow dogs met the inclusion criteria. In 102 cases (96.2%) gender of the chow chow dog was clearly recorded. Of those reported 46 (45.1%) were male and 56 (54.9%) were female with 25 and 31 sexually altered, respectively. There was no significant difference between the distribution of males and females compared to a set of chow chow dogs collected as controls. Information about the timing of neutering (e.g., as juvenile or adult) was not readily available, precluding any further analysis of the role of neutering in disease risk. Age at diagnosis was reported in 88/106 of these dogs (83%) and ranged from 5 to 15 y (mean: 10 ± 2.2 y).

Clinical signs were specifically reported for 48 cases (Figure 1). Most of the dogs (41 of 48) were reported to have more than 1 clinical sign. The mean time interval between onset of clinical signs and diagnosis was 6 wk (median: of 3 wk), but ranged between 4 d and 28 wk.

For 61 dogs, there was no indication of premortem diagnostic evaluation. The remaining 45 dogs underwent premortem evaluation to diagnose and stage the patient, including abdominal sonography, endoscopy, or abdominal exploratory surgery. Abdominal sonography identified a gastric mass in 8 cases (17.8%), 5 of which were confirmed with cytology and 3 of which were confirmed at necropsy. Nine cases (20%) were diagnosed with endoscopic biopsy. Surgical exploratory laparotomy with biopsy was the primary diagnostic method for 28 (62.2%) of the cases.

Location of the tumor was noted in 69 (65.1%) cases. Masses occurred from the cardia to the pylorus. The 2 most common sites for the tumor were diffuse infiltration of the entire stomach and the pylorus. These occurred in 52 (75.4%) and 9 (13.0%) cases, respectively. The remaining tumors occurred in the lesser curvature (n = 3, 4.3%), greater curvature (n = 2, 2.9%), fundus (n = 2, 2.9%) and the cardia (n = 1, 1.5%). Metastatic disease identified through exploratory surgery, ultrasonography, or necropsy was reported in 7 cases. The most common location was lymph node (n = 4), followed by the small intestine (n = 2) and liver (n = 1).

Most patients (43 of 63, 68.3%) were euthanized within 2 wk of diagnosis and only 6 dogs in total were treated. Two of the 6 dogs received 1 chemotherapy treatment alone (docorubicin and carboplatin) and survived no more than 21 d. Two patients underwent surgery alone; they were euthanized 10 d after surgery. Two of the six dogs had long-term survival: 1 was treated with a Bilroth I surgery and doxorubicin (6 treatments) and the other was treated with surgical excision alone. The survival times for these 2 patients were 1 y and 3 y, respectively. In the dog treated with surgery alone, the mass was described as focal and polypoid.

**Histologic classification**

Formalin-fixed paraffin-embedded gastric specimens were histologically reviewed for dogs of the following breeds: 18 chow chow, 7 Belgian shepherd dogs (3 Groenendeal, 4 Tervuren), 1 Boston terrier, one keeshond, and 1 Norwegian elkhound (Table 3). The Lauren classification system which has been used since the 1960’s in characterizing gastric carcinoma into diffuse and intestinal type cancers, was applied to these canine samples (21). All samples were classified as diffuse type tumors.

The WHO classification system divides carcinomas based on cellular differentiation into papillary, tubular, mucinous, and poorly cohesive (also encompassing signet ring differentiation) (Table 3). While 50% of the tumors (14 of 28) exhibited mixed differentiation with more than 1 pattern, papillary differentiation was not observed in any of the tumors. Most tumors
Chow dogs. Only mucinous morphology and both of these occurred in chow dogs (3 of 10, 30%; P = 0.70). However, tumors from chow chow dogs were particularly enriched with mucinous morphology compared to tumors from other dogs (chow chow: 13 of 18, 72%; others: 3 of 10, 30%; P = 0.05). There were 2 tumors that exhibited only mucinous morphology and both of these occurred in chow chow dogs.

Discussion

Our findings are consistent with reports from Europe suggesting an increase in prevalence of gastric carcinoma in a number of breeds of dogs including chow chow and Belgian shepherd (3,15,19). In addition, the current study showed an increased risk in some breeds not previously documented. For instance, we report that terrier breeds including the West Highland white terrier, Scottish terrier, and cairn terrier have an increased risk in some breeds not previously documented. Shepherds (3,15,19). In addition, the current study showed an increase in prevalence of gastric carcinoma in at least portions of the tumor. There was no difference in the occurrence of signet ring morphology between tumors from chow chow dogs compared to those from other breeds (P = 0.36), nor was there any clear difference in the occurrence of tubular morphology between chow chow dogs and other dogs (P = 0.70). However, tumors from chow chow dogs were particularly enriched with mucinous morphology compared to tumors from other dogs (chow chow: 13 of 18, 72%; others: 3 of 10, 30%; P = 0.05). There were 2 tumors that exhibited only mucinous morphology and both of these occurred in chow chow dogs.

**Table 3. Classification of canine gastric carcinoma based on World Health Organization criteria.**

<table>
<thead>
<tr>
<th>Case</th>
<th>Breed</th>
<th>Papillary</th>
<th>Tubular</th>
<th>Mucinous</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chow chow</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>Chow chow</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>Chow chow</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>Chow chow</td>
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<tr>
<td>5</td>
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</tr>
<tr>
<td>7</td>
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Our findings are consistent with reports from Europe suggesting an increase in prevalence of gastric carcinoma in a number of breeds of dogs including chow chow and Belgian shepherd (3,15,19). In addition, the current study showed an increased risk in some breeds not previously documented. For instance, we report that terrier breeds including the West Highland white terrier, Scottish terrier, and cairn terrier have an increased risk. Given the reports of Ménétrier’s disease and associated carcinomas in these breeds, the terrier predisposition for gastric cancer may be distinct mechanistically from that of other breeds (17,23). The increased risk in individual breeds supports the theory that gastric cancer is a heritable disease in the dog (24). In humans, most gastric carcinomas are considered sporadic, although hereditary forms of gastric cancer are thought to occur in about 10% of cases (25). Germline mutations predisposing gastric cancer include those associated with the E-cadherin gene, CDH1, and others (25). In humans there is a correlation between E-cadherin expression and the grade of tumor differentiation, Lauren histologic type, and WHO classification. The diffuse histologic type is more often associated with the genetic abnormalities in humans (25). Interestingly, certain features of human hereditary gastric carcinoma including a predominance of the diffuse (Lauren classification) histologic type, was also observed in the chow chow dogs (26). Whether or not the germline mutations play a role in the canine population has yet to be established. Helicobacter pylori infection is a leading cause of sporadic gastric carcinoma in humans, which is typically intestinal type and occurs most frequently in men (26,27). It is unlikely that H. pylori specifically has a role in canine gastric cancer since natural infection with this organism appears to be rare in dogs and it induces only mild inflammatory reactions with experimental infection (27–30). However, dogs are commonly affected by other gastric Helicobacter (29,31). It is possible that inflammation, microbial induced or otherwise, contributes to canine gastric carcinogenesis. There is also evidence in humans that particular genetic variations in immunologic genes can cooperate with H. pylori in gastric cancer pathogenesis (32).

Gastric cancer in dogs is diagnosed with increasing frequency likely due to several factors. Amorim et al (33) hypothesized that gastric cancer diagnosis may be due to increased availability and development of accurate diagnostic techniques, such as endoscopy. Moreover, the pet’s increasing role as a family member may also contribute to the increased frequency of diagnosis (34). Given the breed associations, it is also possible that breeding practices may have contributed to an increasing risk.

Despite the increased frequency of diagnosis in dogs, gastric cancer remains a diagnostic challenge. Humans with gastric cancer often report subtle and nonspecific clinical symptoms including fatigue, bloating after eating, and feeling full after meals. The early clinical signs of human gastric cancer would likely be overlooked in dogs. Given our data regarding breed predisposition, it would be prudent for veterinarians to pursue more advanced diagnostics in dogs that belong to breeds at high risk of gastric carcinoma and are presented with vague signs.
The clinical signs observed in dogs are analogous to what are termed “alarm” symptoms in humans including dysphagia, anorexia, weight loss, gastrointestinal bleeding, and vomiting. When such signs are present, endoscopy is warranted. However, these alarm symptoms are not always present, and are only reported in 56% to 86% of human patients (27,35–37). In humans such signs are often seen as a negative prognostic indicator.

The canine gastric cancer repository should enable large-scale characterization of the molecular landscape of canine gastric carcinoma. Due to the aggressive nature and negative impact in humans, gastric carcinoma was one of several malignancies selected by the cancer genome atlas project (TCGA) for complete genomic analysis of large sets of human tumors. The TCGA data demonstrate that human gastric carcinoma is comprised of distinct molecular subtypes (1). It would be useful to compare the molecular characteristics of canine and human gastric carcinoma using our specimens. This might assist in developing diagnostic aids for the dog and for identifying targets.

In conclusion, while gastric cancer is uncommon in the dog population as a whole, dogs of certain breeds, including the chow chow have a significantly increased odds of this disease. While gastric carcinoma is considered low on the list of differentials for dogs exhibiting nonspecific signs, it would be warranted to consider a more aggressive diagnostic approach in dogs that belong to breeds at high risk. Gastric cancer in the chow chow dog is similar to hereditary diffuse gastric carcinoma in dogs that belong to breeds at high risk. Gastric cancer associated with Ménétrier’s-like disease in a West Highland white terrier. J Small Anim Pract 2012;53:714–718.


References


Transhiatal esophagogastric anastomosis and postoperative monitoring of thoracic esophageal leiomyosarcoma in a dog

Seungju Lee, Seongjoon Park, Miyeon Kim, Soonpil Hwang, Hwi-yool Kim

Abstract — A 12-year-old Maltese dog was referred to the Veterinary Teaching Hospital at Konkuk University because of severe regurgitation. Radiography, ultrasonography, and computed tomography showed a mass in the thoracic esophagus. Localization of the tumor, its extraluminal nature, the positioning and involvement of the stomach, and the lack of diffuse metastasis to the lung were factors considered when developing a surgical plan. A successful surgical procedure was performed. The final diagnosis was leiomyosarcoma. Following surgery, clinical signs were significantly reduced and postoperative complications were not observed. The dog died 25 days after surgery; we suspected that the death was due to postoperative stricture.

Key clinical message:
Surgical approaches that prioritize maintenance of low tension on the thoracic esophagus are important to prevent arrhythmia, bradycardia, and ventricular premature complex during esophagogastric anastomosis. In dogs with a small esophageal lumen anastomosis may lead to postoperative stricture.

Primary esophageal cancers are rarely reported in dogs and account for less than 0.5% of all malignant tumors in dogs and cats with leiomyosarcoma and squamous cell carcinoma being the most frequently reported among these neoplasms (1,2). Primary esophageal tumors are treated by surgical removal and chemotherapy. Previous studies have shown that esophageal surgery has a higher postoperative complication rate than other surgeries due to the absence of serosa and omentum, longitudinal tension weakness of the esophageal tissue, segmental blood supply, and constant motion of the suture site (3–7). Furthermore, there is a paucity of information regarding surgical planning, procedure, and postoperative monitoring of tumors in the thoracic esophageal region of dogs, due to the difficulty in gaining surgical access and the advanced stage of tumor progression. In 2004, Ranen et al (8) reported a survival range of 2 to 16 mo after partial esophagectomy in 6 dogs. In 2008, Farese et al (9) reported that despite the large size of the tumor and incomplete excision, surgical removal of low-grade leiomyosarcoma resulted in long-term resolution of clinical signs in 4 dogs. However, surgical planning, specific surgical procedure, postoperative monitoring, and prognosis of esophagogastric

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anastomosis have not been fully described in small breed dogs. Surgical planning, procedure, and postoperative monitoring in a case of resection of thoracic esophageal leiomyosarcoma in a Maltese dog are described herein. The findings in our case may aid in formulating guidelines and strategies for surgical treatment of thoracic esophageal tumors in dogs.

Case description
A 12-year-old, 2.3 kg castrated male Maltese dog was referred to the Veterinary Teaching Hospital at Konkuk University for evaluation of a gastroesophageal mass. Clinical signs included severe regurgitation, vomiting, weight loss, drooling, anorexia, and coughing. Blood analysis showed mild leukocytosis [WBC: 18.2 × 10^9/L; reference range (RR): 5.05 to 16.76 × 10^9/L], thrombocytosis [thrombocyte count (PLT): 693 × 10^9/μL; RR: 148 to 484 × 10^9/μL], and mildly elevated alanine aminotransferase (ALT: 130 U/L; RR: 10 to 100 U/L). The referring animal hospital-initiated treatment with amoxicillin/clavulanic acid at a dose of 13.75 mg/kg body weight (BW), PO, famotidine at 0.5 mg/kg BW, PO, and tramadol at 4 mg/kg BW, PO, every 12 h for 1 wk prior to referral.

Physical examination at our veterinary teaching hospital showed mild dehydration, and generally poor body condition. A complete blood (cell) count (CBC), serum biochemical analysis, and electrolyte analysis showed thrombocytosis (PLT: 804 × 10^9/μL; RR: 148 to 484 × 10^9/μL) and mildly elevated alkaline phosphatase (ALP: 243 U/L; RR: 23 to 212 U/L).

Thoracic and abdominal radiographs showed a large, poorly defined soft tissue opacity between the caudal vena cava and caudal thoracic aorta, and radiopaque material in the gall bladder. Thoracic and abdominal ultrasonography revealed a nodular mass (3.3 × 2.1 × 2.8 cm) in the thoracic esophageal region. The mass showed hyperechoic foci with distal acoustic shadowing within and was continuous with the gastric and esophageal walls. Prominent lymph nodes, either hepatic or jejunal, were detected.

Endoscopy showed that the esophageal mucosa layer associated with the mass was intact and appeared normal. The extraluminal mass induced narrowing of the esophageal lumen space. Endoscopic biopsies of the esophageal mucosa were non-diagnostic.

A computed tomography (CT) scan of the thorax and abdomen was performed in order to define the margins of the mass and detect metastasis. The mass was spherical, with multifocal mineralization identified on the precontrast images (Figures 1A, C). On post-contrast imaging, a heterogeneously hypoattenuating mass surrounded the caudal esophagus (Figures 1B, D). The mass was cranially connected to the esophageal wall and caudally connected to the cardia which was infiltrated in both muscular layers. No metastatic lesions were detected in the lung.

The esophageal mass was excised via ventral midline celiotomy. During the celiotomy procedure, a hepatic mass in the quadrate lobe, which had not been detected in preoperative imaging, was observed. Therefore, a total quadrate lobe lobectomy was also performed. A transhiatal approach was used for access to the thoracic esophageal tumor. The esophagus and diaphragm were gently dissected to expose the mass at the thoracic esophagus and gastroesophageal junction. Following dissection, it became obvious that the mass was infiltrating the ventral trunk of the vagus nerve. Stay sutures were placed on the proximal and distal aspects of the mass to manipulate the esophagus and stomach, prevent leakage of the intraluminal contents, and confirm the location of the mass. The mass extended from the gastroesophageal junction to 3 cm orad to the junction (Figure 2A). Gastric resection was performed approximately 3 cm orad to the gastroesophageal junction using a PROXIMATE Linear Cutter (TLC100; Ethicon, Johnson & Johnson, Somerville, New Jersey, USA; Figure 2B), and the thoracic esophagus was resected approximately 4 cm orad to the proximal gastroesophageal junction using a # 10 blade. During resection, mass infiltration of the ventral part of the esophageal vagus nerve was confirmed, and a portion of the nerve was resected along with the mass. A stab incision into the gastric fundus was used for visualization of the lumen, and esophagogastroanastomosis was accomplished using a single layer of simple interrupted sutures with 4-0 polyglyconate (Maxon monofilament; Medtronic, Dublin, Ireland). During esophageal retraction for the anastomosis, the dog developed a sudden ventricular premature complex, bradycardia, and hypotension. Normal sinus rhythm and blood pressure returned after approximately 2 min of chest compression and injection of lidocaine.

To prevent leakage and dehiscence at the anastomosis region.
and improve gastric outflow, omentopexy and Heineke-Mikulicz pyloroplasty were performed. After anastomosis, an orogastric tube was placed and methylene blue was injected; absence of leakage in the anastomosis area was confirmed. To minimize tissue tension, the stomach was displaced approximately 3 cm in a cephalad direction into the thoracic cavity, then the diaphragm and fundus of the stomach were sutured. After anastomosis, an enteral nutrition tube was secured in the jejunum.

Grossly, the esophageal mass was firm, cauliflower-shaped, and measured $1.7 \times 3.3 \times 3.0$ cm. The cut surface of the mass was gray-white. The liver mass was firm and measured $1.5 \times 3.8 \times 2.3$ cm, and the cut surface was red-black. Histology revealed that the esophageal mass had formed by proliferation of the muscle layer (Figure 3A). Spindle-shaped cells proliferated in a bundle, and the nuclei and nucleoli were enlarged (arrows). Although mitotic figures were rarely observed, characteristic anisocytosis of the nuclei and the nucleolus led to our diagnosis of leiomyosarcoma (Figure 3B). The liver mass was composed of proliferative hepatocellular neoplastic cells growing toward the surrounding liver parenchyma, with proliferation and cirrhotic tissue

![Figure 2. A – Appearance of thoracic esophageal mass (arrows). B – Gastric resection using the PROXIMATE Linear Cutter (TLC100; Ethicon, Johnson & Johnson, Somerville, New Jersey, USA).](image)

![Figure 3. Microscopic appearance of thoracic esophageal mass. A – Mass formation due to proliferation of the muscle layer (arrows). H&E stain; bar = 200 μm. B – The spindle-shaped cells proliferated in a bundle, and the nuclei and nucleoli were enlarged (arrows). H&E stain; bar = 10 μm.](image)
changes around the portal triad and central vein. Therefore, final diagnosis of the hepatic mass was suspected hepatocellular carcinoma (Figure 3B).

Drooling, coughing, regurgitation, and vomiting disappeared immediately after surgery. Eight days after surgery, a contrast fluoroscopic esophagogram confirmed absence of leakage or obstruction in the anastomosis area (Figure 4). The jejunal tube was therefore removed, and oral nutrition commenced. Regurgitation and vomiting then recurred, but support of the dog in an upright position for 10 min after feeding significantly reduced these symptoms. The serum liver enzyme levels improved gradually during hospitalization from ALP 301 U/L, ALT 199 U/L, AST 71 U/L, 8 d after surgery to ALP 193 U/L, ALT 64 U/L, AST 30 U/L, 14 d after surgery. However, the CBC revealed leukocytosis and thrombocytosis (from WBC: 25.63 × 10^9/L, PLT: 518 × 10^9/μL, 8 d after surgery to WBC: 49.81 × 10^9/L, PLT: 1331 × 10^9/μL, 14 d after surgery). Vital signs indicating inflammation were not observed, broad-spectrum antibiotics were ineffective, blood culture yielded negative results, and serum C-reactive protein (CRP) levels were normal to slightly elevated [from 95.3 nmol/L (RR: 9.5 to 95.3 nmol/L) at 8 d after surgery to 133.3 nmol/L at 14 d after surgery].

The dog was discharged 15 d after surgery, and follow-up was conducted every second day by telephone. The dog was reported to be anorexic and was regurgitating and vomiting. The dog died 25 d after surgery owing to suspected postoperative esophageal stricture.

Discussion

Dogs with primary esophageal tumors may show no clinical signs until the tumor becomes large enough to cause almost complete obstruction (10). These animals may display regurgitation, depression, lethargy, drooling, dysphagia, anorexia, and weight loss (2,10). The preferred treatment is surgical removal of the mass, but esophageal surgery has historically been thought to result in a high complication rate (4). Commonly reported postoperative complications of esophageal surgery are respiratory complications, persistent regurgitation, dehiscence, leakage, and stricture formation (3,5,6,11).

In our case, the dog had a cough that was inconsistent with other clinical signs of esophageal tumor. Radiography of the thoracic region showed no signs of lung infiltration or pulmonary edema. We therefore suspected that the cough arose from an extraluminal mass effect due to airway compression. Regurgitation and vomiting had occurred a month before referral, a delay that often results in a poor prognosis. The tumor was localized between the thoracic esophagus and the gastroesophageal junction, with no sign of diffuse pulmonary metastasis. The clinical signs were severe, generating an urgent need to relieve the dog’s distress. We did not attempt percutaneous biopsy in this case due to the intrathoracic location of the mass. Therefore, verification of the tumor was needed for chemotherapy or further treatment. These factors influenced our decision to proceed with surgery. Coloninterposition, esophageal stent, and esophago-gastric anastomosis were considered as surgical options, but colonic interposition in dogs is hampered by limited motility of the vascular pedicle (3), and experimental use of free colon autografts has yielded unsatisfactory results (12). The mass in our case was extraluminal, so we judged that esophageal stent placement would not resolve clinical signs such as coughing. Therefore, esophago-gastric anastomosis was chosen as the most promising option. In esophago-gastric anastomosis, leakage and stricture are the main concerns (13). Several studies have shown that omentopexy with esophago-gastric anastomosis reduces the risk of these complications in humans and dogs (14–16). In 1991, Fok et al (17) reported a higher incidence of gastric outlet obstruction and pulmonary complications in human patients who did not have pyloroplasty after esophago-gastric anastomosis (17). Based on these studies, we planned to perform omentopexy and Heineke-Mikulicz pyloroplasty.

The approaches to a thoracic esophageal mass are categorized as transthoracic or transhiatal (18). In this case, the mass was located on the thoracic esophagus and extended to the gastro-esophageal junction occupying approximately 1/6 the total length of the esophagus. The transhiatal approach is associated with relatively few complications (14,19,20). The total length of the dog’s esophagus was approximately 18 cm. For cases in which the mass is in a proximal section of the esophagus, the transhiatal approach leads to excessive tension in the esophagus, and thoracotomy is a more appropriate approach.

Following traction of the esophagus during the anastomosis component of the procedure, our patient developed hypotension, bradycardia, and ventricular premature complexes that were concurrent with stable anesthesia and the absence of any influence of medication on the cardiac rhythm. In human medicine, hypotension and arrhythmia during transthiatal esophagectomy are observed routinely (21,22). These circumstances suggest that the arrhythmia in our patient was induced by vagal nerve stimulation caused by excessive tension of the esophagus.
Therefore, in esophageal surgery it is important to approach the thoracic esophagus while maintaining low tension. In order to minimize tension on the esophagus while using the transthoracic approach during esophagogastric anastomosis, the extent of resection of the esophagus must be limited. In cases in which excessive excision of the esophagus is expected, a transthoracic approach via thoracotomy should be considered in the surgical planning.

Serum liver enzyme concentrations gradually decreased to normal after surgery. Therefore, we assumed that elevated levels on presentation were due to the suspected hepatocellular carcinoma. Complete blood cell count confirmed persistent leukocytosis and thrombocytosis. Multiple cultures, including blood cultures, were performed several times but all were negative. Serum D-dimer levels were normal on all hospitalization days; C-reactive protein levels were slightly increased. Antibiotics were ineffective, and there were no remarkable findings on physical examination throughout hospitalization. Therefore, we ruled out infection or inflammatory response. In previous studies, thrombocytosis was detected in canine hepatocellular carcinoma (23,24) and human studies have shown that people with gastrointestinal neoplasia may have thrombocytosis resulting from cytokines such as granulocyte-macrophage colony-stimulating factor (GM-CSF) or thrombopoietin (TPO) produced by neoplastic cells (25–28). These studies led us to assume that the persistent thrombocytosis and leukocytosis in our patient were most likely due to paraneoplastic syndrome. We did not measure serum cytokine levels, such as GM-CSF or TPO, so we cannot confirm the cause of the thrombocytosis and leukocytosis as a paraneoplastic syndrome.

A limitation of this case study is that the dog survived only a short time due to an unidentified reason. Although the cause of death was not verified as a necropsy was not done, and regurgitation and anorexia had persisted after discharge. Additionally, the dog had an esophageal lumen that was too small for use of the anastomosis device and many suture knots in the small-sized lumen were made by hand-sewn anastomosis using 4-0 maxon. These factors suggested to us that the dog had postoperative stricture formation. The dog died a short time after the surgical procedure. According to other studies, leiomyosarcoma and hepatocellular carcinoma have a relatively long median survival time after surgical procedure compared to this case (8,9,23).

Thoracic esophagectomy for cancer resection is technically challenging, and various factors should be considered in the surgical plan. We considered tumor location, the extraluminal nature of the tumor, the positioning and involvement of the stomach, and the lack of diffuse metastasis to the lung. The resulting procedure led to improved clinical signs immediately after surgery, and absence of leakage was confirmed after surgery. Therefore, we thought the initial purpose of the surgery was accomplished through esophagogastric anastomosis. But the survival time was short and since we did not verify the cause of death via necropsy, we cannot exclude postoperative complication. To prevent postoperative stricture in small size dogs, extra procedures such as oblique anastomosis should be considered.

Acknowledgment

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Case Report  
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Ketoconazole-induced transient hypoadrenocorticism in a dog

Alyssa M. Sullivant, Patty Lathan

Abstract — A 6-year-old, spayed female, mixed breed boxer dog was presented for decreased appetite, polyuria and polydipsia, and lethargy 9 days after treatment with ketoconazole for Malassezia pododermatitis. Ketoconazole-induced hypoadrenocorticism was confirmed with an adrenocorticotropic hormone (ACTH) stimulation test, and ketoconazole was discontinued. Clinical signs resolved 48 hours after initiation of prednisone, and resolution of glucocorticoid insufficiency was confirmed with a repeat ACTH stimulation test 48 hours after a 10-day course of prednisone. Glucocorticoid insufficiency after administration of a commonly used dermatological dose of ketoconazole has not been previously reported in veterinary medicine but should be considered in patients with adverse effects while receiving ketoconazole.

Key clinical message:
Iatrogenic hypoadrenocorticism may occur in dogs treated with commonly used dermatological doses of ketoconazole. The disease is likely transient, but steroid supplementation may be required in some patients to resolve clinical signs, especially in the presence of concurrent illness or stress.

Résumé — Hypoadrénocorticisme transitoire induit par le kétoconazole chez un chien. Une femelle Boxer mélangée stérilisée et âgée de 6 ans fut présentée pour une diminution d’appétit, de la polyurie et de la polydipsie, ainsi que de la léthargie 9 jours après un traitement avec du kétoconazole pour une pododermatite à Malassezia. L’hypoadrénocorticisme induit par le kétoconazole fut confirmé par un test de stimulation avec une hormone adrénocorticotropique (ACTH), et le kétoconazole fut arrêté. Les signes cliniques ont cessé 48 heures après le début d’un traitement à la prednisonale, et la résolution de l’insuffisance de glucocorticoides fut confirmée par une répétition du test de stimulation à l’ACTH 48 heures après 10 jours de traitement à la prednisonale. L’insuffisance de glucocorticoids après l’administration d’une dose de kétoconazole fréquemment utilisée en dermatologie n’a pas été préalablement rapportée en médecine vétérinaire mais devrait être considérée chez des patients présentant des réactions adverses lorsqu’ils reçoivent du kétoconazole.

Message clinique clé :
De l’hypoadrénocorticisme iatrogénique peut survenir chez des chiens traités avec du kétoconazole avec des doses fréquemment utilisées en dermatologie. La maladie est probablement transitoire, mais une supplémentation en stéroïde pourrait être requise chez certains patients afin de résoudre les signes cliniques, spécialement en présence de maladie concomitante ou de stress.


Ketoconazole is an imidazole antifungal drug that prevents synthesis of the essential cell wall component ergosterol by inhibition of the cytochrome P450 enzyme lanosterol 14α-demethylase (1). Historically, ketoconazole was used for systemic fungal infections, but newer triazoles such as itraconazole and fluconazole are now preferred due to superior efficacy (1). Ketoconazole remains an effective treatment for canine Malassezia dermatitis and dermatophytosis at a dosage of 5 to 10 mg/kg body weight (BW), q24h for 21 d (1). Adverse effects of ketoconazole occur in 10% to 15% of dogs, and although more common at higher dosages, adverse effects may also be independent of dosage (2). Common side effects include gastrointestinal upset, cutaneous drug reactions, and liver enzyme elevation (2). Hepatotoxicity has been reported and is typically reversible after discontinuing ketoconazole (1). However, at a daily dose of 80 mg/kg BW, icterus and death have occurred.

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(2). Ketoconazole potently inhibits the P450 enzyme CYP3A and p-glycoprotein and therefore may cause significant drug interactions (1).

Although not a preferred treatment due to poorer efficacy, ketoconazole may be used to treat hyperadrenocorticism, as it inhibits cortisol synthesis via inhibition of cytochrome P450 enzymes in the adrenal cortex (3). Adequate control of clinical signs of canine hyperadrenocorticism usually requires dosages significantly higher (10 to 30 mg/kg BW, q12h) than standard anti-fungal doses (5 to 10 mg/kg BW, q24h) (3–6). Signs of cortisol insufficiency in dogs treated with ketoconazole are, therefore, not expected with commonly used dermatological doses (3–5). However, ketoconazole-induced adrenal insufficiency has been described in humans (7,8). To the authors’ knowledge, this is the first report of hypoadrenocorticism in a dog due to ketoconazole administration to treat a fungal infection.

Case description
A 6-year-old, spayed female, 20 kg mixed breed boxer dog was presented to the internal medicine service at Mississippi State University Animal Health Center with a 1-week history of profound polyuria and polydipsia (PU/PD), decreased appetite, and lethargy. The dog had a history of atopic dermatitis and had received oral hydroxyzine (Vistaril; Harris Pharmaceutical, Fort Myers, Florida, USA), 2.3 mg/kg BW, q8h, for pruritus. She also had a history of separation anxiety and was treated with fluoxetine (Prozac; Morris and Dickson, Shreveport, Louisiana, USA), 1 mg/kg BW, q24h. Except for monthly ivermectin/pyrantel (Heartgard; Boehringer Ingelheim, Duluth, Georgia, USA), the patient had not received any other medications, including glucocorticoids, or undergone any anesthetic procedures for at least 2 mo before presentation. At the time of presentation, she had been receiving ketoconazole (Nizoral; Mylan Pharmaceuticals, Canonsburg, Pennsylvania, USA), 4.5 mg/kg BW, q12h for 9 d for Malassezia pododermatitis. The owner noted an increase in the dog’s water consumption 2 d after starting the ketoconazole (Figure 1), and the dog also had urinated 3 times in the house over the last week. The urine appeared clear, and the amount was normal to increased, according to the owner. No dysuria was noted. Four days prior to presentation to the internal medicine service, the dog was evaluated for the suspected polyuria and polydipsia (PU/PD) by the community veterinary service at Mississippi State University Animal Health Center. At that time, the dog had received ketoconazole for 5 d. A urinalysis revealed a urine specific gravity of 1.008 and an inactive sediment. A urine culture yielded no bacterial growth after 48 h. The dog was then referred to the internal medicine service at Mississippi State University Animal Health Center.

On presentation to the internal medicine service, the dog was bright and alert with normal vital parameters. She postured normally and urinated a large amount of clear urine on the clinic floor during the examination. A weight loss of 1 kg over the previous 9 d was noted. A serum chemistry profile revealed moderately increased creatinine [194.5 µmol/L; reference interval (RI): 44.2 to 123.8 µmol/L]. The blood urea nitrogen, alkaline phosphatase, alanine aminotransferase, bilirubin, albumin, and electrolytes were within normal reference ranges. A repeat urinalysis was not performed, as the dog had completely voided her bladder upon presentation. No significant abnormalities were found on abdominal ultrasound. A baseline cortisol measured with a chemiluminescent immunoassay (Immulite; Siemens Healthineers, Germany) was 27.6 nmol/L. One hour following intravenous administration of cosyntropin, (Cortrosyn; Amphastar Pharmaceuticals, Rancho Cucamonga, California, USA), 5 µg/kg BW, the serum cortisol concentration was 27.6 nmol/L, confirming hypoadrenocorticism. Results of the baseline cortisol were available at the end of the day on a Friday, so results of the ACTH stimulation test were not available until the following Monday (12 d after ketoconazole was started; Figure 1). The patient had not received any glucocorticoids that might interfere with ACTH simulation results for at least 2 mo prior to presentation.

Glucocorticoid insufficiency secondary to ketoconazole was suspected, but not confirmed; therefore, oral prednisone (PredniSONE; Boehringer Ingelheim; Koln, Germany), 0.38 mg/kg BW, q24h, was started on day 12. Ketoconazole was continued to complete the 2-week course to treat pododermatitis and the last dose was given the morning of day 14, 2 d after prednisone treatment had been initiated. The dog’s appetite and PU/PD improved the morning after prednisone was started (day 13), and these signs were completely resolved within 48 h (the morning of day 14), prior to her final dose of ketoconazole. Prednisone was tapered to 0.25 mg/kg BW, q24h after 3 d. Repeat ACTH stimulation test with the same immunoassay 48 h after completing a 10-day course of oral prednisone confirmed resolution of hypoadrenocorticism (pre-ACTH cortisol < 27.6 nmol/L; post-ACTH cortisol 157.3 nmol/L) (Table 1). The dog’s body weight had increased to 21 kg and she continued to do well without glucocorticoids; the clinical signs of hypoadrenocorticism did not return. Six months after initial presentation, electrolytes and ACTH stimulation results were within the reference ranges (pre-ACTH 69.0 nmol/L; post-ACTH 350.4 nmol/L) (Table 1). The dog’s CBC and serum chemistry values, including BUN and creatinine, were within the reference ranges, and her urine specific gravity was 1.029. At the time of this report, approximately 3 y after initial diagnosis of hypoadrenocorticism, the dog remains clinically normal.

Discussion
This is the first documented report of ketoconazole-induced transient hypoadrenocorticism in the dog. Of interest is the relatively low dosage (4.5 mg/kg BW, PO, q12h) at which clinical signs of adrenal insufficiency occurred. In a study by Feldman et al (3), little or no reduction in cortisol levels occurred at 5 mg/kg BW, q12h (3). At higher dosages, ketoconazole inhibits cortisol synthesis in the adrenal cortex primarily via blockade of 11-hydroxylase and is consequently a commonly used medical treatment for pituitary-dependent hyperadrenocorticism (HAC) in humans (4,9). Ketoconazole is also used by some veterinarians to treat canine HAC, but dosages up to 20 to 30 mg/kg BW, q12h may be required to control clinical signs (4–6).

In contrast to veterinary medicine, ketoconazole-induced adrenal insufficiency has been reported in humans (7,8). Clinical symptoms of transient adrenal insufficiency in humans have
and urination beginning 2 d after ketoconazole was started. The owner noticed a significant increase in water consumption and sensitivity; Chem — serum chemistry; ACTH stim — adrenocorticotropic hormone (ACTH) stimulation test.

Unfortunately, aldosterone concentrations were not measured in our patient. Although ketoconazole inhibits several other enzymes involved in cortisol synthesis, it does not typically inhibit aldosterone synthase (CYP11B2), even at dosages of 30 to 40 mg/kg BW per day (7,9–11). Studies have shown that administration of 10 mg/kg BW per day does not affect basal and post-ACTH aldosterone levels in dogs (10,11). However, rare cases of hypoaldosteronism due to ketoconazole administration have been reported in both dogs and humans (7,9–11). All electrolyte concentrations were normal in our patient, but baseline and post-ACTH aldosterone levels in dogs (10,11). However, irreversible hypoadrenocorticism remained necessary for the entire 2-year follow-up period after discontinuation of ketoconazole (7).

Although the timing of the onset and resolution of the clinical signs in relation to the initiation of ketoconazole and prednisone, respectively, support our clinical suspicion of ketoconazole-induced hypoadrenocorticism, the authors acknowledge that other causes of lethargy, decreased appetite, and PU/PD are possible in this dog. Gastrointestinal upset and/or inappetence are common side effects of ketoconazole. Since the PU/PD resolved after ketoconazole was discontinued and prednisone therapy was initiated, it is possible that a previously unreported side effect of ketoconazole is polyuria/polydipsia. However, the PU/PD resolved on the second day of steroid supplementation, which was 1 d before discontinuation of the ketoconazole. Renal insufficiency or acute kidney injury was also considered, due to the presence of mild azotemia (elevated creatinine) and isotnenuria. However, all clinical signs and PU/PD resolved after treatment with prednisone, the patient’s creatinine was normal, and urine specific gravity was 1.029, 6 mo after presentation. To the authors’ knowledge, ketoconazole has not been reported to cause renal damage. It also seems unlikely that acute kidney injury would resolve so quickly without therapy, but this should be considered as a cause for this patient’s clinical signs and azotemia. Although a possible adverse effect of ketoconazole, hepatotoxicity was considered less likely in our patient due to absence of elevation of liver enzyme activity and/or bilirubin concentration, and cholesterol, BUN, glucose, and albumin concentrations being within the reference ranges. However, a direct test of liver function, such as an ammonia tolerance test or bile acid determination, was not performed.

At the time of diagnosis, the dog was also receiving hydroxyzine for pruritus and fluoxetine for separation anxiety. Hydroxyzine is a H1-receptor antihistamine that antagonizes histamine effect, and its most common side effect is sedation (15). Fluoxetine is a selective serotonin reuptake inhibitor antidepressant used to treat some behavioral disorders in dogs and cats. Because of changes these drugs might cause with CYP
enzyme activities, their concurrent use with ketoconazole could have potentially increased ketoconazole levels, predisposing the dog to ketoconazole-related adverse effects, such as hypocortisolism. However, it is more likely that as a potent inhibitor of CYP450 enzymes, ketoconazole would have increased hydroxyzine and/or fluoxetine levels. Regardless, it is important for clinicians to consider the metabolism and clearance of medications that are used concurrently, as each medication may increase drug concentrations of another medication, predisposing the patient to adverse effects.

Rapid clinical recovery occurred with oral prednisone at approximately twice the physiological dose. The dog’s anorexia may have resolved with discontinuation of the ketoconazole alone. However, due to the confirmation of hypoadrenocorticism, we elected to treat with a short course of glucocorticoids while the patient completed the previously prescribed ketoconazole and then treat for an additional 7 d. Although the dog’s ACTH stimulation test results were low enough to cause clinical signs from hypoadrenocorticism, it is impossible to know whether the decreased appetite and lethargy were due to hypoadrenocorticism, ketoconazole, or a combination. Failure to determine aldosterone concentrations is also a limitation of this report, as these may have provided further support of a definitive diagnosis.

Ketoconazole is a commonly used imidazole drug, often prescribed for canine fungal infections, particularly Malassezia dermatitis and dermatophytosis (1). Gastrointestinal upset and decreased appetite are the most common side effects, but these adverse effects typically improve or resolve with temporary drug discontinuation, dose reduction, or administration with food (1,2). Permanent discontinuation of ketoconazole and alternative antifungal therapy may be necessary in some cases, especially if hepatotoxicity is suspected (2). Ketoconazole may be used to suppress cortisol production in hyperadrenocorticism, and the doses required to do so are variable, although typically higher than commonly used dermatological doses. The dog in this report was receiving a relatively low dose of ketoconazole for Malassezia dermatitis; however, the pharmacokinetics of ketoconazole may vary from dog to dog, similar to what is reported in humans (8). Due to the potential consequences of ketoconazole on adrenal function, even at low doses, veterinarians should also consider cortisol insufficiency as the cause of adverse effects in dogs receiving ketoconazole, particularly in a stressed patient or in patients with anxiety disorders or those receiving concurrent medications, such as the dog herein. An ACTH stimulation test is recommended if gastrointestinal signs do not resolve with drug discontinuation or if other signs of hypoadrenocorticism such as lethargy or polyuria and polydipsia occur. The incidence of ketoconazole-induced hypoadrenocorticism in dogs is unknown, but the present case increases awareness of its possibility. Based on the current human literature, ketoconazole-induced hypoadrenocorticism is likely transient in most cases, but steroid supplementation may be required in some patients to resolve clinical signs, especially in the presence of concurrent illness or stress (7,8).

Acknowledgment

The authors thank Ali Tobia, DVM, for allowing us to write this manuscript about her dog and for her help with the details of the patient’s history and treatment response.

References

Case Report Rapport de cas

Suspected acute pancreatitis in a dog following honeybee envenomation

Jennifer Groover, Michael Schaer, Leonel Londoño

Abstract — This report details an unusual clinical presentation of suspected acute pancreatitis that occurred after honeybee envenomation in a dog. A 13-year-old spayed female dog was presented for further evaluation of vomiting 3 days after honeybee envenomation. Abdominal ultrasound, fine-needle aspirate cytology, and blood analysis were used to establish the diagnosis. The dog recovered following supportive care. While bee envenomation induced acute pancreatitis has been reported in human literature, to the authors’ knowledge, this is the first reported case in a dog in which pancreatitis ensued soon after envenomation.

Key clinical message:
This report describes a case of a dog with honeybee envenomation that subsequently developed acute pancreatitis. Given the widespread presence of the honeybee across the globe, while rare, it is important that clinicians are aware of potential envenomation sequelae such as acute pancreatitis.

Résumé — Suspicion de pancréatite aigüe chez un chien à la suite d’une envenimation par des abeilles.
Le présent rapport donne les détails d’une présentation clinique inhabituelle d’une suspicion de pancréatite aigüe qui est survenue à la suite d’une envenimation par des abeilles chez un chien. Une chienne stérilisée âgée de 13 ans fut présentée pour évaluation plus poussée de vomissements 3 jours après envenimation par des abeilles. Une échographie abdominale, une cytologie d’aspiration à l’aiguille fine et une analyse sanguine furent utilisées afin d’établir le diagnostic. La chienne a récupéré à la suite d’un traitement de support. Alors que l’envenimation par les abeilles induisant une pancréatite aigüe a été rapportée dans la littérature humaine, à la connaissance de l’auteur ceci est le premier cas rapporté chez le chien dans lequel une pancréatite est apparue peu de temps après l’envenimation.

Message clinique clé :
Ce rapport décrit le cas d’un chien avec envenimation par des abeilles qui développa subséquemment une pancréatite aigüe. Étant donné la présence répandue des abeilles à travers le globe, bien que rare, il est important que les cliniciens soient au fait des séquelles potentielles d’une envenimation telle qu’une pancréatite aigüe.

Hypersensitivity reactions to hymenopteran stings are diverse and can range from mild local abnormalities to severe life-threatening anaphylactic reactions. Intravascular hemolysis, acute kidney injury, pulmonary edema, cerebral edema, multiple organ dysfunction, and pancreatitis are all reported systemic reactions in humans (1,2). While the human literature shows multiple stings are often necessary to cause such severe systemic effects, there are reports of single stings resulting in multiple organ dysfunction (1–5). Adverse effects including acute kidney injury have recently been reported in the dog (6).

Bees, aculeate wasps, yellow jackets, hornets, and fire ants are venomous insects that are part of the insect order Hymenoptera, which contains over 92 000 species (7). Bee venom contains histamine, dopamine, phospholipase A1 (PLA1), phospholipase A2 (PLA2), hyaluronidase, and toxic peptides such as the hemolysin, mellitin, mast cell degranulators, and neurotoxin apamin (8,9). Phospholipases are active components of several animal species’ venoms as well as mammalian pancreatic secretion (3). Reports of pancreatitis after bee and wasp stings are rare in human medicine, being documented only 6 times in the literature (1–5). To the authors’ knowledge, this is the first reported case in the veterinary literature in which acute pancreatitis is associated with hymenopteran envenomation in a dog. While it is difficult to prove that hymenopteran venom directly causes pancreatitis, it is important that clinicians are aware of this possible sequela.
Case description

A 13-year-old spayed female husky mixed breed dog was presented to the emergency service for vomiting and suspected acute pancreatitis as a referral by her primary veterinarian. The dog was reportedly normal until the owner witnessed the dog in the back yard being stung by a honeybee, an event that was soon followed by rapidly developing facial and lingual swelling. The dog was tachypneic and weak on initial examination. A sting site was identified on the left side of the tongue by the primary veterinarian. The dog was excessively licking, which was thought to have dislodged the stinger. The dog was treated with dexamethasone (Aspen Dexasone; Sparhawk Laboratories, Lenexa, Kansas, USA), 0.4 mg/kg body weight (BW), IM, once, diphenhydramine (Diphenhydramine HCl Injection; Baxter Healthcare, Deerfield, Illinois, USA), 0.8 mg/kg BW, IM, once. The swelling markedly decreased after this treatment.

After the event, the owner reported that the dog never reverted to normal as evidenced by signs of progressive depression, inactivity, and decreased appetite. Vomiting ensued 3 d later and the dog was returned to the primary veterinarian. Biochemical analysis was done on withdrawn blood samples (Catalyst One; IDEXX Laboratories, Westbrook, Maine, USA), and the results showed elevated amylase and lipase activities, alkaline phosphatase, and liver transaminase enzymes (Table 1). The dog was hospitalized and treated with famotidine (Famotidine; West-Ward, Eatontown, New Jersey, USA), 0.2 mg/kg BW, IV, q8h, maropitant citrate (Cerenia; Pfizer Animal Health, New York, New York, USA), 1.2 mg/kg BW, IV, q24h, ampicillin (Ampicillin; Hanford Manufacturing, Syracuse, New York, USA), 20 mg/kg BW, IV, q12h, and lactated Ringer’s solution (Cathartic One; IDEXX Laboratories, Westbrook, Maine, USA), 0.8 mg/kg BW, IM, once. The dog was tachypneic and weak on initial examination. The abdomen was painful to palpation, and the dog appeared grossly uncomfortable as evidenced by stiff posturing. There were no localizing neurological abnormalities to explain the cause of the ataxia which was evidenced by stiff posturing. The abdomen was hyperechoic and hyperattenuating. A moderate amount of anechoic fluid was present throughout the peritoneal cavity. The peripancreatic fat was subsequently attributed to abdominal pain and suspected pancreatic abnormalities to explain the cause of the ataxia which was subsequently attributed to abdominal pain and suspected chronic coxo-femoral osteoarthritis.

An abdominal ultrasound examination showed an enlarged pancreas measuring up to 5 cm in width with diffusely hypoechoic parenchyma (Figure 1). The peripancreatic fat was hyperechoic and hyperattenuating. A moderate amount of anechoic fluid was present throughout the peritoneal cavity. Additional findings included hepatomegaly, bilateral adrenal nodules (1.7 cm diameter each), and bilateral degenerative renal changes. Pancreatitis was suspected based on the ultrasonographic findings. Cytology of the peritoneal fluid obtained by ultrasound-guided fine-needle aspiration showed a non-septic exudate with numerous red blood cells and degenerate neutrophils without any evidence of infectious organisms or neoplastic cells. A fine-needle aspirate of the pancreas was obtained, and the cytological evaluation, which was returned the next day, indicated mildly atypical pancreatic epithelium with mild neutrophilic inflammation compatible with acute pancreatitis (Figure 2). No infectious organisms or neoplastic cells were identified.

The dog was treated supportively with parenteral lidocaine (VetOne Lidocaine 2%; MWI, Boise, Idaho, USA), 25 µg/kg BW per min and ketamine (Ketaset; Phoenix Pharmaceuticals, Burlingame, California, USA), 3 to 5 µg/kg BW per min continuous rate infusions titrated to effect. Enteral feeding via a nasogastric tube with Jevity (Jevity 1.5 Cal; Abbott Laboratories, Columbus, Ohio, USA) was titrated from 1/4 resting energy rate up to full resting energy rate over 2 d, and intravenous lactated Ringer’s solution (Baxter), was initially given at 90 mL/kg BW per day, then titrated to 60 mL/kg BW per day, and then weaned over 4 d. Hypertension with an average reading of 220 mmHg was found on the first day of hospitalization, prompting the administration of antihypertensive drugs [amlodipine (Amlodipine Besylate; Cipla, Sunrise, Florida, USA), 0.18 mg/kg BW, PO, q12h and enalapril (Enalapril Maleate; Wockhardt, Aurangabad, Maharashtra, India), 0.18 mg/kg BW, PO, q12h]. Maropitant citrate (Cerenia; Pfizer Animal Health), 1 mg/kg BW, IV, q24h, was given for nausea and ampicillin-sulbactam (Unasyn; Pfizer Animal Health), 30 mg/kg BW, IV, q12h, was given until the cytology results showed no infectious organisms; after which the antibiotic was discontinued. The ketamine and lidocaine medications were discontinued after 4 days when the dog began eating, and the ataxia resolved on day 5 before discharge.

The dog was discharged on day 6 with amlodipine (Amlodipine Besylate; Cipla), 0.18 mg/kg BW, PO, q12h, enalapril (Enalapril Maleate; Wockhardt), 0.18 mg/kg BW, PO, q12h, and maropitant citrate (Cerenia; Pfizer Animal Health), 2 mg/kg BW, PO, q24. During follow-up at 2 d and again 2 wk after discharge, the owner reported that the dog had done well at home and had completely recovered. Repeat blood analysis performed 2 wk later (Catalyst One; IDEXX Laboratories) by the primary veterinarian showed significantly decreased serum amylase and slightly decreased lipase concentrations (Table 1). A urinalysis showed appropriately concentrated urine (specific gravity of 1.030), normal sediment analysis, and was unremarkable apart from proteinuria. A urine protein-creatinine ratio (UPC) was 4.3 (reference value < 0.5). Enalapril was continued for proteinuria, but amlodipine was discontinued due to persistent clinical signs.

<table>
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<tr>
<th>Biochemistry value</th>
<th>Day 3 after venenomation</th>
<th>Day 20 after venenomation</th>
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<tr>
<td>BUN (mmol/L)</td>
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<tr>
<td>Creatinine (µmol/L)</td>
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<td>110</td>
<td>40 to 160</td>
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<tr>
<td>Phosphorus (mmol/L)</td>
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<td>1.5</td>
<td>0.8 to 2.2</td>
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<tr>
<td>Albumin (g/L)</td>
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<td>22 to 39</td>
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<tr>
<td>Globulins (g/L)</td>
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<td>25 to 45</td>
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<tr>
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</tr>
<tr>
<td>Lipase (U/L)</td>
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<td>4350</td>
<td>200 to 1800</td>
</tr>
</tbody>
</table>

BUN — blood urea nitrogen.

Table 1. Serum chemistry results on a 13-year-old dog with acute pancreatitis following honeybee venenomation and recovery.
resolution of hypertension with repeated measurements of 120 to 140 mmHg after discontinuation.

**Discussion**

Hymenoptera envenomation occurs worldwide and while the episodes typically cause local pain and cutaneous wheal formation, they can also cause life-threatening systemic Type 1 hypersensitivity and other severe inflammatory reactions. This report describes the case of a dog that experienced acute pancreatitis subsequent to honeybee envenomation. This is a rare phenomenon documented in humans and this report outlines the first suspected case in a dog (1–5).

Diagnosis of pancreatitis in the absence of confirmatory histopathology is challenging. Since obtaining histopathology is usually invasive, several other diagnostic tests are often used to support a diagnosis of pancreatitis. The significance of the elevation of amylase and lipase activities in this case is difficult to interpret. Unfortunately, canine pancreas-specific lipase test, abdominal ultrasound, and fine-needle aspirate cytology were not available at the referring veterinary hospital; this may have proved more useful towards suggesting the pancreas as the source of the clinical signs prior to referral. Histopathology is the gold standard diagnosis for acute pancreatitis, but it is not often performed due to its invasiveness (10). While enzyme-linked immunosorbent assay (ELISA) for canine pancreas-specific lipase tests are commonly used in practice, these tests can have up to a 40% false positive rate in the diagnosis of acute pancreatitis in dogs presenting with an acute abdomen, with pancreatic inflammation being secondary to other primary abdominal pathology (11). While a final diagnosis of pancreatitis was made 7 d after the bee sting, which leaves room for the possibility of a different underlying cause, the dog exhibited the same persistent clinical signs at the primary veterinarian as at the referral hospital. This assumes that continuation of the same underlying disease process is more likely than 2 separate diseases. While exacerbation of underlying chronic pancreatitis or glomerulonephritis is also possible, this patient had no history of gastrointestinal or renal disease. The hyperlipasemia on day 20 might indicate that the dog developed indolent pancreatitis after the initial presentation, or perhaps had subclinical disease before the envenomation.

Controversy exists over the role of glucocorticoids in pancreatitis. Anti-inflammatory dosed steroids are frequently used to treat anaphylactic reactions. While there are a few case reports associating steroids as an underlying cause of acute pancreatitis, other prospective studies do not show this correlation (12–14). A recent non-blinded, non-randomized study showed faster clinical improvement and decrease in C-reactive protein levels in dogs treated with prednisolone for acute pancreatitis (15). Dexamethasone has been shown to increase serum lipase activity without any histologic damage to the pancreas (16). Biochemical changes as a result of steroids in addition to the challenge of diagnosing pancreatitis without histopathology may contribute to this controversy. While steroids could theoretically have altered the clinical course of this dog’s disease, the role of glucocorticoids continues to be a debatable topic as the cause of acute pancreatitis.

Hypotension from the suspected initial anaphylactic reaction could have caused ischemia to the pancreas in this dog (7). Acute pancreatitis could also be one of the adverse effects caused directly by the venom, as described in human literature that there can be a delayed appearance for as long as 4 d after the envenomation (4). It is suspected that PLA2 can have direct damaging effect on pancreatic acinar cells, which is compounded by the PLA2 released by infiltrating neutrophilic granulocytes, macrophages, and platelets into the pancreas during acute pancreatitis (17). These can cause leakage of lysosomal enzymes into the pancreatic periacinar tissue causing the premature activation of the zymogens within the parenchyma (3). Additionally, PLA1 can also contribute to IgE immunological inflammatory reactions to hymenopteran venom (9). Literature on humans has shown that the PLA2 concentration may correlate with disease severity and prognosis (3,17).

The additional finding of hypertension in this dog is interesting in light of 2 case reports in humans describing bee sting...
associated hypertension (3, 5). While this dog did not have a history of hypertension, it was diagnosed with this abnormality during its hospitalization. The hypertension associated with bee stings in humans has been explained by the presence of vasopressor amines such as noradrenaline and dopamine found in the honeybee venom (18, 19). In this case, renal changes and abdominal pain likely contributed to the elevation of blood pressure. The presence of bilateral adrenal nodules would have required a follow-up medical evaluation to assess the possibility of the dog having pheochromocytomas or other adenocortical neoplastic processes as the cause of the hypertension. Another possible cause of hypertension was fluid overload. The dog in this case report did not show signs of fluid overload and his body weight ranged from a low of 26.6 kg to a high of 27.4 kg during hospitalization.

Decompensation of chronic kidney disease or immune-mediated glomerulonephropathy from pancreatitis-induced systemic inflammatory response syndrome should be considered in the proposed pathogenesis of the hypertension. This dog had bilateral ultrasonographic changes to the kidneys consistent with chronic kidney disease. A urinalysis showed appropriate concentration with a urine specific gravity of 1.030 but did show proteinuria. Given the urinalysis was obtained 9 d after envenomation, antigen-antibody complexes could have formed in the glomeruli, also explaining the proteinuria. When the patient was still hypertensive 2 wk following discharge, a urinary protein-creatinine ratio (UPC) was done showing an increase to 4.3 (reference range: < 0.5). A report of a human envenomated by a bee describes an immune-mediated membranoproliferative glomerulonephritis based on histopathology that was suspected to be due to direct nephrotoxicity caused by the toxic active amines in hymenopteran venom (20). Due to lack of a urinalysis before the event, it is unknown whether exacerbation of chronic kidney disease or immune-mediated glomerular nephropathy ultimately caused the proteinuria and hypertension in this dog.

In conclusion, this dog had a complex clinical picture involving an immediate hypersensitivity reaction, hypertension, and acute pancreatitis that occurred after bee envenomation. Although rare, given the widespread presence of the honeybee around the globe, it is important that clinicians be aware of potential envenomation sequelae such as acute pancreatitis.

References
Periocular sarcoid with bone invasion in a Thoroughbred mare
Andres Giraldo, Chantale L. Pinard, Brandon L. Plattner, Marie-Soleil Dubois

Abstract — A periocular nodular sarcoid was diagnosed on the right upper eyelid and medial canthus of a 12-year-old Thoroughbred mare. Enucleation was performed and during the procedure the mass was noted to be firmly adhered to the underlying frontal bone. Partial ostectomy of the dorsal orbital rim was performed. Histopathology revealed invasion of the cortical lamellar bone and the bone marrow by neoplastic spindle cells and extension of these cells to multiple surgical margins. Recurrence at the level of the surgical site and its surroundings occurred 3 months after the procedure. The horse was euthanized 12 months later.

Key clinical message:
Invasion of the underlying bone occurs in some cases of equine periocular sarcoids. The case highlights how this bone invasion might affect the surgical planning and shows potential aggressiveness of this type of tumor.


Message clinique clé :
Ce cas démontre que l’invasion de l’os sous-jacent se produit dans certains cas de sarcoïdes péri-oculaires équins. Ce cas souligne comment cette invasion osseuse peut affecter la planification chirurgicale et montre le potentiel agressif de ce type de tumeur.

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Equine sarcoid has been reported to be the most common type of equine integumentary neoplasia worldwide (1–3). Although the exact cause is unknown, a viral etiology has been suggested (1,2). Interestingly, bovine papilloma virus DNA has been found in approximately 90% of sarcoid tissues. However, the presence of papilloma virus DNA does not imply causation, and the role of this virus as a potential cause of sarcoids remains to be determined (1,3). A genetic component has also been associated with the development of sarcoids, and breed predisposition has been documented in Thoroughbreds, Quarter horses, Arabians, and Appaloosas (3). Additionally, increased sarcoid susceptibility has been associated with the presence of MHC-II allele ELA W13 in breeds such as Thoroughbreds and Irish Sport Horses (4).

Six clinical forms of equine sarcoid have been described: occult, verrucous, nodular, fibroblastic, mixed, and malignant or malevolent (1,5). The diagnosis is made based on gross features of the lesion and confirmed by histopathology of surgical biopsies or excised masses. Multiple treatment modalities have been reported, including surgical excision, laser ablation, cryotherapy, hyperthermia, immunotherapy, intralesional injection or topical application of chemotherapy, radiation therapy, and electrochemotherapy (1,3,5–13). Regardless of the treatment, either as a monotherapy or combination, the success and recurrence rates are variable (1,3,5–13).

While local invasion has been extensively described in cases of equine sarcoid (5), cortical bone and bone marrow invasion have not been reported. This case report describes an unusual
case of periorbital sarcoid that invaded the cortical lamellar bone and the bone marrow in a 12-year-old Thoroughbred mare.

**Case description**

A 12-year-old, 480-kg Thoroughbred mare was presented to the Ontario Veterinary College — Health Science Center for evaluation and treatment of a mass associated with the right eyelid. Three months before presentation, a mass of approximately 1 cm in diameter was noted on the upper eyelid near the medial canthus of the right eye. A fine-needle aspiration was performed by the referring veterinarian and cytologic analysis revealed a spindle cell tumor with a high suspicion of sarcoid. Shortly after the needle aspiration, the mass was observed to grow rapidly.

On presentation, the mare was bright, alert, and responsive. Physical examination revealed no anomalies. Ocular examination of the right eye revealed a firm 3 cm × 3 cm nodular mass affecting the medial half of the right upper eyelid (Figure 1). The skin overlying this mass was alopecic. Firm nodules were also noted near the palpebral margin of the medial lower eyelid. No anomalies were noted with the right ocular globe. Neuroophthalmic examination showed that both eyes were normal. Rostral to the medial canthus of the right eye, between the canthus and infraorbital foramen, and measuring approximately 10 cm × 5 cm, alopecic, roughened, and nodular skin was noted above the facial crest, suggestive of a verrucose sarcoid.

Due to the location and the size of the mass and the extent of the adjacent affected skin, complete excision with clean margins was considered unachievable without performing an enucleation of the right eye. Adjunctive therapies that could be performed in addition to debulking of the mass were discussed with the owner but declined due to financial reasons. The mare was administered antibiotics [sodium penicillin (Penicillin G; Fresenius Kabi Canada, Toronto, Ontario), 22 000 mg/kg body weight (BW), IV, and gentamicin (Gentocin; Intervet Canada, Kirkland, Quebec), 6.6 mg/kg BW, IV] and flunixin meglumine (Flunixin; Zoetis Canada), 1.1 mg/kg BW, IV, before surgery. The mare was sedated with xylazine (Xylamax; Bimeda, London, Ontario), 1 mg/kg BW, IV, and anesthesia was induced with ketamine hydrochloride (Narketan; Vétoquinol, Lavaltrie, Quebec), 2.2 mg/kg BW, IV, and diazepam (Diazepam; Sandoz Canada, Boucherville, Quebec), 0.02 mg/kg BW, IV. The horse was placed in left lateral recumbency and isoflurane inhalant anesthetic agent was vaporized in oxygen. A modified Peterson local block was performed with bupivacaine hydrochloride (Marcaine; Pfizer Canada, Kirkland, Quebec), 0.02 mg/kg BW, IV. The right periorbital area was prepared and draped for aseptic surgery according to hospital protocol.

A transconjunctival enucleation was accomplished as described in the literature (14). Briefly, the conjunctiva was incised, the extra ocular muscles were resected at their insertion, and the optic nerve was transected before removing the globe. Subsequently, an elliptical incision was performed around the upper eyelid mass, trying to obtain 1- to 2-cm margins, where possible, and the mass was isolated by sharp dissection. The mass was firmly adherent to the underlying frontal bone; therefore, osteotomy of the affected portion of the bone was performed using an osteotome and a mallet. Margins of approximately 1 cm were obtained. Small masses in the lower eyelid adjacent to the medial canthus were also removed along with the lower eyelid margin. The resected tissues, including the bone, were submitted in 10% neutral buffered formalin for histopathologic analysis. The skin was closed by a combination of simple continuous and tension-relieving patterns (near-far-near and horizontal mattress suture patterns) using USP size 1 polypropylene. The abnormal skin extending rostrally from the medial canthus was left untreated. The surgical site was covered with an elastic bandage to protect the area during recovery. The horse recovered uneventfully from surgery and was discharged from the hospital the following day with instructions to administer trimethoprim sulfamethoxazole (Apo-sulfatrim-ds; Apotex, Toronto, Ontario), 25 mg/kg BW, PO, q12h for 7 d.

Histologically, the dermis and subcutis were expanded by an unencapsulated and variably well-demarcated and infiltrative neoplasm extending from the superficial dermis into the underlying skeletal muscle. The overlying epidermis was hyperkeratotic and irregularly hyperplastic with prominent rete pegs extending into the underlying neoplasm (Figure 2A). The neoplasm was composed of neoplastic plump fibroblasts arranged in whorls, interlacing bundles or haphazard arrays. The cells had
plump nuclei with prominent basophilic nucleoli; mitotic figures were not observed. Near the epidermis, neoplastic cells were frequently oriented perpendicularly to the overlying epidermis (Figure 2B, *). Neoplastic cells extended to multiple soft tissue surgical margins, invaded deeply into and effaced adjacent skeletal muscle (Figure 2C, *), and into the cortical lamellar bone and bone marrow spaces of the underlying frontal orbital bone (Figure 2D). There was bone resorption and loss characterized by scalloped margins, resorption lines, and increased osteoclastic activity. Based on these features, a diagnosis of invasive equine sarcoid was confirmed.

According to the owner (telephone conversation), the horse appeared to have an uneventful recovery from the surgery, with no immediate post-operative complications. However, 3 mo after the procedure, an ulcerated mass developed within the bony orbit at the level of the initial incision. The lesions previously observed on the skin rostral to the medial canthus appeared to worsen and additional lesions were noted on the forehead, axial to the surgery site. The horse was euthanized 12 mo later due to worsening of the condition. No post-mortem examination was performed.

**Discussion**

Equine sarcoid is a species-specific cutaneous neoplasia. A similar condition has been described in cats: feline cutaneous fibropapillomas (feline sarcoid). Feline sarcoid shares comparable histopathologic and clinical characteristics with equine sarcoid; they can both be locally invasive but have a low to nonexistent rate of metastasis, and for both conditions local recurrence is common after treatment (15,16). To our knowledge, bone invasion has not been described for either condition. The term sarcoid, sarcoid-like, or sarcoidosis is used at times in humans;

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**Figure 2.** A – Photomicrograph revealing a cross section of the removed sarcoid, hematoxylin and eosin (H&E) stain (objective: 2×). B – Photomicrograph of the sarcoid; the asterisks show the neoplastic cells oriented perpendicularly to the overlying hyperplastic epidermis. H&E stain. (objective: 10×). C – Photomicrograph of the sarcoid; the asterisk shows neoplastic cells invading adjacent skeletal muscle. H&E stain. (objective: 10×). D – Photomicrograph of the neoplastic cells invading the adjacent cortical bone and into adjacent marrow spaces (#); the asterisks show the bone cortex with evidence of bone resorption including scalloped margins, osteoclasts, and resorption lines. H&E stain. (objective: 10×).
however, in every case these refer to granulomatous inflammatory lesions, not to proliferative lesions like equine sarcoids. Therefore, these are not comparable.

Histopathology is the method of choice to confirm the diagnosis of sarcoid. Characteristic features supporting a diagnosis of sarcoid in this case included spindle-shaped neoplastic cells arranged in whorls and interlacing bundles with variable amount of collagen. Neoplastic fibroblasts located along the dermal-epidermal junction were arranged perpendicularly to the basement membrane; this distinctive histologic feature is present in most sarcoids. There was hyperkeratosis and marked irregular hyperplasia of the epidermis characterized by prominent rete pegs (1,3). In this case, neoplastic cells invaded into the bone, which is a feature that to our knowledge has not been published before. Furthermore, they extended as well to multiple surgical margins of the soft tissues; the latter explains the rapid recurrence of the lesion.

Multiple treatment modalities have been described with variable success for sarcoids in horses. The location of the lesions and the infiltration of neoplastic fibroblasts into adjacent dermal connective tissues make complete surgical excision difficult in many cases (4). Therefore, the local recurrence rate is high and either repeated treatments or multiple treatment modalities are often recommended to increase the therapeutic success. Moreover, management of periorbital sarcoids is known to be more challenging and these sarcoids carry a worse prognosis than at other locations (4). Extensive debulking or excision is not always possible due to the anatomy of the head and the limited skin available (17). For this reason, surgical clean margins are often difficult to obtain without enucleation or exenteration (18). Additionally, maintaining the normal function of the eyelids is crucial for corneal health. Some treatment modalities are not available for periorcular sarcoids as their complications can directly affect eyelid function and therefore bring severe consequences for vision (5).

The treatment choice in this case was partly influenced by economic constraints. Local injections of chemotherapeutic drugs such as cisplatin have been reported after surgical debulking of sarcoids, but because multiple injections are required along with several re-evaluations, associated with higher costs, this option was declined by the client. Other options include electrochemotherapy, laser ablation, hyperthermia, cryotherapy, topical 5-fluorouracil cream, brachytherapy, and immunomodulation with intra-lesional injections of Bacillus Calmette-Guerin (BCG) (1,3,5–13). However, these options were not considered due to higher cost and lack of availability. Debulking of the mass and enucleation was chosen as it was an economical single treatment that offered the patient an increased level of comfort. Should the client have had a greater budget, adjunct therapy after surgery would have been planned in order to address the unclear margins and remaining lesions.

With respect to surgical technique, a transpalpebral approach is recommended in cases with neoplasms; however, in this case, a transconjunctival enucleation was elected to allow better manipulation of the eyelids and underlying orbital bone. Partial osteotomy of the orbital rim has been previously described in cases of extensive periorcular tumors treated surgically (19). Beard and Wilkie (19) described how in one of their cases, the sarcoid was adhered to the orbital rim, similar to what we found in our case. Although histopathology was not performed in that case, sarcoid adhesion to the bone could be suggestive of bone invasion.

It has been previously reported that even with aggressive surgical excision, the recurrence rate for periorcular sarcoids in horses is as high as 82% (5,18). Additionally, recurrence of sarcoids is typically observed in lesions with more aggressive biologic behavior (3). In this case we observed local recurrence, as well as extension of lesions to the forehead and maxillary area, which was expected based on the presence of neoplastic fibroblasts observed histologically along several surgical margins.

Sarcoids tend to reactivate or become more aggressive after biopsies or surgical excision (1,2,17). It certainly appears to be the case in our patient, given that shortly after the fine-needle aspiration performed by the referring veterinarian, the mass exhibited an increased growth rate. However, it is unknown why in this case the mass invaded the bone. Although it cannot be excluded that neoplastic cells were seeded in the deeper tissues while needle aspiration was performed by the referring veterinarian, after discussion with this individual and consideration of the technique that was employed, this hypothesis seems unlikely. It appears more probable that this was the inherent behavior of this tumor. The true etiology of the condition remains unknown.

In summary, this case describes the clinical and histopathologic features of a sarcoid, a common tumor in horses, with an unusual presentation involving invasion of the underlying orbital bone. To the authors’ knowledge, this is the first report of a sarcoid presenting with cortical bone and bone marrow invasion. Sarcoids commonly affect dermal and subcutaneous tissue and can be locally infiltrative in adjacent soft tissue, but do not usually invade hard tissue such as bone.

References


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Field application of a commercial porcine reproductive and respiratory syndrome virus (PRRSV) oral fluid antibody enzyme-linked immunosorbent assay (ELISA)

Emily Croft, Tim Blackwell, Jeff Zimmerman

Abstract — A commercial porcine reproductive and respiratory syndrome virus (PRRSV) oral fluid antibody enzyme-linked immunosorbent assay (ELISA) was used on 31 commercial swine farms in Ontario using oral fluid samples (~6 per herd) collected from cotton ropes. Using the manufacturer’s cutoff [sample-to-positive ratio (S/P) ≥ 0.4], 2 of 135 oral fluid samples from 23 PRRSV presumed negative herds tested positive (1.5% false positive rate). Three approaches to improving test diagnostic specificity were compared: i) use a cutoff of S/P ≥ 0.8 for individual oral fluid samples; ii) use the current cutoff of S/P ≥ 0.4 but use a mean S/P based on several oral fluid samples (6 samples were used in this study); and iii) use serial testing to resolve unexpected positive ELISA results, i.e., retest using a reverse transcription-polymerase chain reaction (RT-PCR) to determine whether low positive S/P ratios are the result of early PRRSV infection in a barn.

Résumé — Application sur le terrain d’une épreuve immuno-enzymatique (ELISA) commerciale pour détecter des anticorps contre le virus du syndrome reproducteur et respiratoire porcin en utilisant des fluides oraux. Une épreuve immuno-enzymatique (ELISA) commerciale pour détecter des anticorps contre le virus du syndrome reproducteur et respiratoire porcin (VSRRP) en utilisant des fluides oraux fut utilisée sur 31 fermes commerciales en Ontario en utilisant des échantillons de fluides oraux (~6 par troupeau) prélevés en utilisant des cordes en coton. En utilisant le seuil recommandé par le manufacturier [ratio échantillon-à-positif (S/P) ≥ 0.4], 2 des 135 échantillons de fluides oraux provenant de 23 troupeaux présumés négatifs pour le VSRRP ont testé positif (taux de faux positifs de 1,5%). Trois approches pour améliorer la spécificité du test furent comparées : i) utilisation d’une valeur seuil de S/P ≥ 0.8 pour les échantillons de fluides oraux individuels; ii) utilisant de la valeur seuil actuelle S/P ≥ 0.4 mais utiliser une S/P moyenne basée sur plusieurs échantillons de fluides oraux (6 échantillons furent utilisés dans la présente étude); et iii) utiliser des tests en série pour résoudre les résultats ELISA positifs non-attendus; retester en utilisant la réaction d’amplification en chaine par la polymérase avec la transcriptase reverse (RT-PCR) afin de déterminer si les ratios S/P faiblement positifs sont le résultat d’une infection débutante dans une ferme.


Porcine reproductive and respiratory syndrome virus (PRRSV)-infected herds often experience large economic losses due to PRRSV-induced reproductive losses in sows and respiratory disease in growing pigs. Preventing and/or avoiding losses must be a prime objective of every successful pig producer, but PRRS management decisions require accurate and timely information, i.e., surveillance data.

Particularly when used in coordination with PRRSV reverse-transcription polymerase chain reaction (RT-PCR) testing, PRRSV antibody-based surveillance can provide actionable information regarding herd PRRSV status, virus circulation, and/or vaccination history (1). Traditionally, serum samples have been used in PRRSV antibody testing, but oral fluid samples likewise contain detectable levels of PRRSV-specific antibody and commercial PRRSV oral fluid ELISAs are available (2). In addition, oral fluid sampling is less invasive for pigs and more convenient for stock people. Oral fluid-based PRRSV surveillance can be particularly useful in low prevalence situations or...
when large numbers of animals need to be sampled routinely over time. Oral fluids are as diagnostically effective as sera at detecting antibody positive pigs, but unexpected positive results have raised concerns and limited the use of oral fluids on farms for surveillance purposes (3). Therefore, the objectives of this study were: i) to compare the results of PRRSV oral fluid antibody testing in Ontario swine herds to the manufacturer's stated values for test diagnostic sensitivity and specificity, and ii) to compare 3 methods to address unexpected positive test results.

To compare the accuracy of PRRSV oral fluid antibody testing in Ontario swine herds to the manufacturer's stated values, samples were collected from a convenience sample of herds (n = 31) located in southern Ontario. Herds were initially categorized as PRRSV naïve (non-infected/non-vaccinated; n = 26) or infected (n = 5) based on the producer's assessment, which may or may not have included recent laboratory testing. This approach was chosen to reflect how the test was being applied in Ontario and to determine if the unexpected positive results anecdotally reported by producers and veterinarians would be observed. A priority was given to testing PRRS naïve herds to evaluate if complaints from the field regarding false positive results were routine.

Oral fluid samples were collected by hanging lengths of cotton rope (1.6 cm diameter, ~30 cm in length) in 6 pens throughout each barn. Only 1 barn per farm was sampled. Samples were therefore clustered within farms. Six ropes per barn were used to approximate the common field application of oral fluid sampling for PRRSV for the typical size of Ontario finishing barns (1000 to 2000 head). Pen selection was based on convenience sampling with regard to the ease of hanging ropes in high activity areas within pens. Pen occupancy rates varied from 15 to 200 pigs per pen, with most barns housing between 20 and 40 pigs per pen. Specific counts of pigs per pen or number of pigs interacting with a rope were not performed. Pigs were between 2 and 5 mo of age at the time of testing to ensure consistency with the common use of the oral fluids ELISA test in the field. All sampling was performed in finishing barns except for 2 farms on which late nursery pigs (2 mo of age) were tested. After permitting the pigs to chew on the rope and the small volume of oral fluid collected from each rope. In 2 of the study herds, the pigs pulled down some of the ropes which were not recovered. As a result, 4 samples were collected from 1 PRRSV naïve herd and 5 from another PRRSV naïve herd. Six samples were successfully collected from each of the remaining 29 herds for a total of 183 oral fluid samples.

Three herds initially reported as PRRSV naïve by the owner were reclassified as PRRSV positive based on strongly positive oral fluid antibody testing followed by strongly positive serum antibody testing. Thus, of the 31 participating herds, 23 were categorized as PRRSV naïve and 8 as PRRSV positive. This resulted in 135 oral fluid samples from naïve herds and 48 from PRRSV positive herds.

As shown in Figure 1A, oral fluid ELISA S/P values ranged from 0.0 to 0.44 in the 23 herds categorized as PRRSV negative and 0.1 to 7.4 in the 8 herds categorized as PRRSV antibody positive. In herds classified as PRRSV negative, 2 of 135 oral fluid samples (1.5%) had S/P values at or above the 0.4 cutoff (0.43 and 0.44). These 2 samples originated from different herds. Both herds received pigs from PRRS naïve sources and continued to test PRRS negative on subsequent RT-PCR testing of oral fluids following the completion of this study. Among the PRRSV antibody-positive herds, 1 of 48 oral fluid samples (2.1%) had an S/P value below the 0.4 cutoff (0.1). As shown in Figure 1B, mean S/P values in negative herds ranged from 0.0 to 0.3. In contrast, mean S/P values in positive herds ranged from 2.4 to 6.2.

This study was undertaken to examine undocumented reports from the field stating that the oral fluid PRRS ELISA test produced an unacceptably high number of false positive results in PRRS naïve herds. The methodology applied here to investigate the reports of false positive results was limited due to the study's reliance on the owner's estimation of the PRRS status of
the barns. It did, however, accurately reflect how the test was used by producers and practitioners, including the convenience sampling of pens within barns. The results of this study reflected the field reports with respect to unexpected positive results. The 1.5% false positive rate found in this study was consistent with the manufacturer's reported diagnostic specificity of 98.7% (Personal communication, Dr. Silvia Zimmerman, IDEXX, Westbrook, Maine, USA). Therefore, the methodology applied here likely identified the problems that practitioners were reporting regarding test accuracy, while being consistent with the manufacturer's stated value for test specificity. In certain situations, a 98.5% specificity is acceptable for diagnostic purposes. However, when used for regular disease surveillance purposes, a 1.5% rate of unexpected positive results (“false alarms”) undermines confidence in the test (4). For example, if the oral fluids ELISA test was used routinely prior to moving pigs from a PRRS naïve nursery to a naïve finishing barn and 6 rope samples were submitted per group with 8 groups per year passing through the nursery, a false positive result could be expected on average to occur every 1 to 2 y. This would result in an unnecessary disruption of pig flow for the operators.

In this study, the PRRSV positive herds, individual pen sample S/Ps were as high as 7.5 and were generally much higher than the manufacturer’s recommended cutoff of S/P ≥ 0.4 (5). Thus, 45 of the 48 pen samples from the 8 PRRSV antibody positive herds had S/P values ≥ 0.8. Three samples, each from a different PRRSV antibody positive herd, had S/P values of 0.1, 0.5, and 0.7. In fact, S/Ps < 0.4 from a PRRSV positive barn may reflect the true PRRSV antibody status of that pen at the time of sampling because the virus can take weeks to spread to all pens of pigs within a facility. Regardless, if the 48 oral fluid samples from the 8 PRRSV positive herds in this study were assumed to originate from PRRS infected pigs, a cutoff of S/P ≥ 0.8 would result in a diagnostic sensitivity of 93.7% at the individual sample level. However, testing 6 samples per barn resulted in a diagnostic sensitivity of 100% at the barn level. Thus, setting the individual sample cut-off at S/P > 0.8 resulted in 100% diagnostic specificity at the individual sample level as well as 100% sensitivity at the barn level when 6 samples were collected per barn. A more appropriate cut-point may be identified in the future when larger data sets are examined but using 0.8 in this study accurately categorized all the herds tested.

Porcine reproductive and respiratory syndrome virus infection may not be uniformly distributed throughout a positive barn. Collecting several oral fluid samples increases the probability of including a positive pen in the sampling, but larger sample sizes also increase the possibility of a false positive result. An approach that addresses the latter concern is to use the mean S/P value

![Figure 1. Frequency distribution of PRRSV oral fluid ELISA S/P test results (IDEXX PRRS Oral Fluids Ab Test; IDEXX Laboratories, Westbrook, Maine, USA). A — 135 oral fluid samples from PRRSV-negative herds (n = 23) and 48 oral fluid samples from PRRSV-positive herds (n = 8). B — Mean PRRSV oral fluid ELISA S/P calculated from the individual oral fluid test results (usually 6) from each herd.](image-url)
calculated from several individual pen samples to establish barn status. In this study, the mean S/P calculated from 4 to 6 individual pen results clearly differentiated PRRSV negative (mean S/P range 0.0 to 0.3) from PRRSV antibody positive (mean S/P range: 2.4 to 6.2) barns and resulted in a diagnostic specificity of 100% at a cutoff of S/P ≥ 0.4. Using mean S/P values runs the risk of missing an early PRRSV infection by diluting a true low positive reactor that is captured on only 1 of several oral fluid samples, but this can be resolved by periodic testing over time.

The third approach to addressing unexpected low positive S/P ratios involves “serial testing” of the original sample using a test based on a different assay format, i.e., a different antibody test or a test for nucleic acid. For example, testing blood samples for PRRS antibodies as done in this trial can confirm or refute unexpected positive results from ELISA testing of oral fluids. Likewise, RT-PCR testing could be performed on an oral fluid sample with an S/P ratio ≥ 0.4 from a location where all other pen test results were < 0.4. This would be particularly appropriate to exclude the possibility that a recent PRRSV introduction was the cause of a single low positive reaction. The latter approach does not require additional sample collection and could be requested as soon as the unexpected positive ELISA result was received. Serial testing is routinely used in disease control programs because false positive results invariably increase as disease prevalence declines.

In this study, oral fluid samples were found to be a practical and effective alternative to serum samples when testing for PRRSV antibodies. Collecting oral fluids using cotton ropes hung in pens was less stressful for pigs, as well as quick, simple, and convenient for animal caretakers. The results of this study (98.5% specificity) agreed with previous studies regarding the diagnostic specificity (98.7%) of the IDEXX PRRS oral fluids ELISA for individual samples. However, this level of diagnostic specificity at the individual pen sample level, is not sufficiently high for routine use in commercial swine herds. Three approaches to improving test specificity are proposed where multiple oral fluid samples are collected per location: i) use a positive cutoff of S/P ≥ 0.8 for individual pen oral fluid samples; ii) use the manufacturer’s recommended cutoff of S/P ≥ 0.4, but establish barn status using the mean S/P calculated from several oral fluid samples (6 samples were used in this study); and iii) Use serial testing to confirm or refute unexpected oral fluid test results. RT-PCR testing is likely the most appropriate test when low positive reactors could result from an early stage PRRSV infection.

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References

Segmental uterine aplasia and ipsilateral renal agenesis in a ragdoll cat

D’Arcy Dykeman

Abstract — During a routine ovariohysterectomy on a 5-month-old ragdoll cat, right-sided segmental uterine aplasia and ipsilateral renal agenesis were discovered. The diagnosis was confirmed with histopathology. This condition is congenital and is a result of a failure of embryonic development of the paramesonephric ducts. Uterine aplasia and renal agenesis is a rare finding in cats but the prevalence in the ragdoll breed appears to be higher than in the general cat population.

Résumé — Aplasie utérine segmentaire et agénésie rénale ipsilatérale chez un chat ragdoll. Lors d’une ovariohysterectomie de routine chez une chatte ragdoll âgée de 5 mois, une aplasie utérine segmentaire du côté droit et une agénésie rénale ipsilatérale furent découvertes. Le diagnostic fut confirmé par histopathologie. Cette condition est congénitale et est le résultat d’une défaillance de développement embryonnaire des conduits paramésonéphriques. L’aplasie utérine et l’agénésie rénale sont des trouvailles rares chez les chats mais la prévalence chez la race ragdoll semble être plus élevée que dans la population générale de chats.


A 5-month-old female ragdoll cat was presented to the Brooklin Veterinary Hospital for routine vaccinations and consultation regarding ovariohysterectomy (OHE). At this time a date for the OHE was set but routine pre-surgical blood analysis was declined. As the final booster vaccinations in the routine kitten series would be completed within 2 wk of the date set for the OHE, the surgery was postponed and an alternative date was set. Prior to the newly scheduled date, the owner contacted the clinic and asked for the OHE to be completed promptly as the cat appeared to be entering her first heat cycle. On the day of the OHE procedure presurgical blood analysis was again declined.

A midline incision was made just caudal to the umbilicus through the skin, subcutaneous tissue, and linea alba. The left ovarian horn was identified via the use of a spay hook. The left ovarian pedicle was ligated, and the uterine horn was followed to the uterine body. It was difficult to identify the bifurcation of the uterine body, and the right uterine horn could not be located using this method. The surgeon attempted to locate the right uterine horn with the spay hook but was unsuccessful. The midline incision through all 3 layers was extended caudally, but still the bifurcation and the right uterine horn could not be identified. At this time no palpable cervical structure could be identified. The midline incision was then extended through all 3 layers cranially to create an exploratory laparotomy incision.

The surgeon then began to examine the contents of the abdominal cavity, and identified a right ovary attached to a ligamentous structure which terminated in the surrounding broad ligament before reaching the uterine body (Figure 1). The right ovarian pedicle was ligated and the ovary, as well as the abnormal structure, were removed. During this exploratory laparotomy, it was noted that the right kidney and ureter were absent.

After completion of the OHE an abdominal ultrasound was performed to assess the abdominal organs and to confirm the absence of the right kidney. Routine post-operative pain management for cats following OHE at this clinic consists of meloxicam (Metacam; Boehringer Ingelheim, Burlington, Ontario), 0.05 mg/kg body weight (BW), SC; however, oral transmucosal buprenorphine, 0.02 mg/kg BW, compounded by Chiron Compounding Pharmacy, Guelph, Ontario was prescribed in this specific case because it is considered less nephrotoxic than meloxicam. At discharge the client was informed of the surgical findings and was cautioned that the cat may develop insufficient kidney function in the future. It was explained that cats with 2 kidneys frequently develop renal failure and it is likely that this condition may result in an earlier age of onset as the cat has only 1 functioning kidney doing the work of 2.

Baseline blood analysis to assess current renal function was not elected at this time.

The excised left and right ovaries and associated uterine structures were fixed in formalin and sent for histopathology at the Animal Health Laboratory (AHL), University of Guelph, Ontario.
(Figure 2). This investigation confirmed the diagnosis of segmental right uterine aplasia and ipsilateral renal agenesis. Results showed that the associated uterine tissue contained smooth muscle, collagen, and blood vessels but lacked any normal uterine tissue. In contrast to these abnormalities, the right ovarian structure was normal, as were the isthmus and infundibulum.

**Discussion**

Embryological development is a complex process that relies on a very specific series of events to occur to allow for complete development (1). When signals do not occur at the precise embryonic cell stage, development continues in an abnormal pattern (1). This may cause agenesis or dysgenesis, which results in complete absence of an organ or an abnormal organ, respectively (1). Congenital abnormalities are thus the result of the misfiring of signals during embryologic development, and result in alterations of structure and function of organs and physiologic systems (1). The urogenital tract arises due to complex interactions between 2 cell populations (2). The urinary tract and tubular uterine system develop from a set of cells originating in the intermediate mesoderm, while the ovaries develop from the gonadal ridge (2). This common ancestry of renal and uterine structures explains why renal and uterine abnormalities often occur in conjunction with one another, and the degree to which they are affected depends on the timing of the abnormal signals received by the tissues (2). The uterine tract itself forms from paired müllerian (or paramesonephric) ducts which elongate toward each other and fuse, thus uterine abnormalities can be seen on one or both sides of the tract (3,4). As the ovaries develop from a distinct cell population at the gonadal ridge, and respond to a different set of signals, the ovaries are often normal in the face of congenital urogenital abnormalities (2).

Segmental uterine aplasia (commonly referred to as uterus unicornis) is a condition in which portions of the tubular genital tract (uterus, cervix, and vagina) are not present (5,6). There are varying presentations of this anomaly which is caused by alterations in the timing of signaling mistakes (2,4). Signal misadventures occurring earlier in development lead to an anomaly which begins in a more proximal location of the tract and halts normal development of the rest of the organ, and thus a larger portion of the tract is affected than when the signal is disrupted at a later stage of development (2,4). Segmental uterine aplasia and ipsilateral renal agenesis are frequently identified together in animals with 2 normal ovaries, but the exact mechanism resulting in this failure is unknown (2). Mayer–Rokitansky–Küster–Hauser syndrome type 2 (MRKH t2), is a known human condition that has similarities in presentation to this condition in animals, which is inherited via an autosomal dominant mutation with incomplete penetrance and variable expressivity (7). However, MRKH t2 is not an exact replica for the condition

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**Figure 1.** Normal left uterine horn (white arrow) compared with the aplastic right uterine horn (black arrow) in situ. The aplastic horn is shown to be terminating without attachment to the uterine body.

**Figure 2.** Normal left uterine horn and ovary (white arrow) compared with the aplastic right uterine horn with normal ovary (black arrow) removed during surgery.
seen in animals, and studies show low inheritance from affected female animals suggesting a more complex inheritance pattern likely involving more than 1 gene or signal (2,7).

While abnormalities can be seen in various species and body systems, urogenital abnormalities are rare in mammals and are seen most commonly in livestock animals (6). Segmental uterine aplasia with ipsilateral renal agenesis is most frequently seen in companion animals but are seen at almost twice the rate in cats (0.09%) compared with dogs (0.05%) (8). In cats with uterine abnormalities such as segmental uterine aplasia, ipsilateral renal agenesis is present in approximately 30% of cases (8). Ragdoll cats appear to be more commonly affected with this condition than are other cat breeds (5). Renal abnormalities such as chronic interstitial nephritis and polycystic kidney disease are commonly found in ragdoll cats as well and screening for such diseases can lead to the identification of segmental uterine aplasia with ipsilateral renal agenesis in otherwise healthy cats (9). Regardless of breed, this anomaly most commonly occurs on the right side of the body for reasons which are unknown (6,9). Cats presenting for OHE with this condition will almost always have 2 ovaries, and it is thus imperative that both are found and removed to successfully prevent heat cycles (4). It is also crucial that the extent of the condition is identified to take measures to preserve renal function of the sole kidney in future medical or surgical interventions (4).

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Moving from compassion fatigue to compassion resilience  
Part 3: Causes of compassion fatigue  
Debbie L. Stoewen

Having previously focused on the significance of compassion (1) and understanding compassion fatigue (2), this article focuses on the causes of compassion fatigue, specifically the many realities of life in clinical practice that can make veterinary caregivers so susceptible. For those who work in clinical practice, these realities will come as no surprise. What may come as a surprise, however, is the range of stressors that can culminate as compassion fatigue. Interwoven within any one scenario may be an intricate variety of stressors, making what may seem on the surface as simple and straightforward, actually quite complex. When caught up in the moment, or busily moving through the day, we may not realize the extent to which we are challenged—physically, intellectually, emotionally, and socially, and even morally. To engage in veterinary caregiving is, quite simply, to engage with complexity. We attend to imperatives and even morally. To engage in veterinary caregiving is, quite simply, to engage with complexity. We attend to imperatives.

There has been a great deal of research on stress in veterinary clinical practice (3–7). The rate of stress is thought to be moderately high to high, and, by all accounts, rising (8). The very nature of what we do, contending with the prevention, diagnosis, and treatment of disease, disorder, and injury, exposes us to the suffering of patients and distress of clients, which inherently gives rise to compassion stress, the central precursor to compassion fatigue (9). Beyond this, certain other realities of life in practice—and how we respond to them—can contribute to compassion fatigue. In exploring the causes, keep in mind that as we work towards helping them understand the feasibilities. They may also arrive with diverse psychosocial and emotional needs, requiring support as they navigate the health concerns or crisis their pet (and family) is facing. Today’s role as veterinary caregivers is demanding; we are not just health care providers for our patients, but also emotional support workers (i.e., ad hoc counsellors) for our clients (11). Veterinary services have increasingly shifted from providing care solely to animals to caring for both the animals and their owners (12). The honoring of the human-animal bond is a necessary and positive shift in the profession, yet it can increase the risk of psychological stress (7,13).

Despite this shift, and consequent risk, veterinary curricula have not devoted much time to the study of the human-animal bond (11,14), including how to break bad news or support the guilt and grief of euthanasia (10,15). This gap in veterinary education can have serious consequences as caregivers become enmeshed in intense emotional scenarios for which they have little to no training (16).

Most clients are appreciative of, and amenable to, veterinary recommendations, but there are always exceptions, often related to the specifics of the circumstances. At these times, clients may be found to be difficult. They may dispute the findings, diagnostic and treatment options, and fees and billing, or refuse payment. Conflictual conversations about health care and the cost of care can become emotionally charged, and the stress from these interactions tends to linger long afterwards. Added to this is the risk of cyberbullying, now a real concern in the veterinary profession (17). The most common impacts of cyberbullying are workplace tension and mental health problems, both of which increase the risk of compassion fatigue.

As pets are legally recognized as property, clients have the right to determine the type and extent of care their pet receives. This places veterinary caregivers, dedicated to acting in the best interests of animals (18), in a place of relative powerlessness (12). They may be faced with extremes, from requests to prolong pet’s lives beyond what is in their best interest to ending their lives when care could easily make them healthy and well again (15,19). When it comes to patient care, the decisions that are made are strongly influenced by factors unrelated to the patient. When clients make decisions that collide with the veterinarians’ supposed advocacy role, it can create ethical or moral dilemmas with resultant distress. Moral distress, as coined by Andrew Jameton (20), is “the experience of knowing the
right thing to do while being in a situation in which it is nearly impossible to do it’ (20,21). Recent research has identified that veterinarians face ethical conflict and moral distress regularly in the normal course of practice (22). Furthermore, it appears that most veterinarians have little to no training on how to navigate these dilemmas and resolve the conflict to reduce the impact of these problems (22). Any situation that causes moral distress is, quite simply, a stressor, and although moral distress is different from compassion fatigue, it definitely contributes to it. When we cannot follow our own moral compass and need to engage in actions that are inconsistent with it, the painful feelings and psychological disequilibrium increase our vulnerability to compassion fatigue (20).

Moral distress can especially be felt in relation to performing and/or witnessing euthanasia (15). Euthanasia can create a sense of having failed the animal or of having betrayed the contract of care, especially when we have come to know the patient well (23). Beyond being a source of moral distress, euthanasia is a source of grief, which can deeply affect veterinary caregivers (19). As well as being unable to “solve” the client’s grief, we ourselves grieve, and typically have very little time to debrief, reflect, or process this grief, having to resume regular duties immediately afterwards. All of this has a toll on caregivers (24), and it is a repeated toll. Veterinarians experience death five times more often than physicians (13). Exposure to death incurs both short- and long-term emotional impacts (19).

Managing workload, finances, administration, and co-worker relationships

Outside of the many sources of compassion stress and moral distress, anything that contributes to burnout can contribute to compassion fatigue. This includes long work hours, excessive workload, emergency on-call, work-home interference, under-staffing, lack of resources, low remuneration, low profit margins, financial pressures (e.g., individual or practice loans), and administrative duties (12,25,26) — all of which can wear us down, reducing our resilience. These circumstances are made worse when there are difficult relationships with co-workers or conflict in the workplace (12). Any and all of these factors reduce job satisfaction, and the less satisfied a veterinary caregiver is with their employment, the greater the risk of compassion fatigue (27).

Job complexity, isolation, and medical errors

As veterinary medicine continues to advance, becoming increasingly sophisticated and specialized, and the bar for professional standards set at ever greater heights, there is an increasing need — and pressure — to keep up with new skills and technology. High levels of job complexity and concern about maintaining skills and expertise have been directly linked to the risk of compassion fatigue (9,27). Compounding the necessity to keep up is the relative social and professional isolation that is experienced in veterinary medicine (28). In human medicine, physicians routinely collaborate with other physicians — peer-to-peer or peer-to-specialist — openly reviewing cases and sharing ideas within a multitiered medical system. Veterinarians, on the other hand, tend to work within independent, fully operationalized hospitals with little supervision, mentorship, or access to assistance from colleagues. Not only is isolation a source of stress, it is ripe with the potential for medical errors. Medical errors and unexpected outcomes can have considerable emotional impact and incur the risk of complaints and litigation (29), with further emotional impact.

Who we are and how we carry ourselves

This article would not be complete without mentioning that it is not just the nature of veterinary medicine and stressors of clinical practice — altogether the veterinary environment — that makes us vulnerable to compassion fatigue, but also who we are and how we carry ourselves in this environment. It depends on our values, mindsets, and ability to tolerate stress and distress. It depends on our coping skills and strategies, and the choices we make as we respond to our environment. The degree to which we are resilient in the face of challenges — able to bounce back from difficult experiences — influences vulnerability (30). Key to resilience is knowledge, having awareness of the issues and how they can be managed. The more we learn about compassion fatigue, the greater the opportunity to remain resilient — and thrive, despite the challenges!

Having focused on the causes of compassion fatigue, the next article will focus on the signs and consequences, specifically the changes that occur and how they impact health and well-being, professional efficacy, organizational success, and career trajectory.

References

17. AVMA Cyberbullying — and How to Handle It. Available from: https://www.avma.org/PracticeManagement/Administration/reputation/Pages/cyberbullying.aspx Last accessed February 21, 2020. (only available to AVMA members)

Answers to Quiz Corner
Les réponses du test éclair

1. A) Bradycardia is a sign of calcium toxicity during fluid therapy.
   A) La bradycardie est un signe de toxicité par le calcium durant une fluidothérapie.
2. C) Idiopathic megaesophagus is the most common cause of esophageal hypomotility in dogs.
   C) Le mégaœsophage est la cause la plus commune d’hypomotilité œsophagienne chez le chien.
3. A) Infection is usually subclinical in adult cats.
   A) L’infection est habituellement subclinique chez les chats adultes.
4. C) Cranial nerve deficits with no other clinical signs are characteristic of a lesion in the peripheral nerve portion of the cranial nerve.
   C) Des déficits relatifs aux nerfs crâniens sans autre signe clinique sont caractéristiques d’une lésion de la portion périphérique des nerfs crâniens.
5. A) The spleen is a common site for metastasis of large melanomas of the external genitalia. It is less likely that the horse has 2 types of tumors.
   A) La rate est un site courant de métastases lors de grands mélanomes affectant les organes génitaux externes. Il est moins probable que le cheval ait deux types de tumeurs.
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How tapping into his creative side led one veterinarian to greener pastures

Natalie Morrissey

You may not have visited Dr. Cody Creelman in his practice, but you may have seen one of his YouTube videos, worn some swag from his clothing line “Palpation Nation,” or read one of his blogs. One thing is certain, Dr. Cody Creelman is constantly looking for ways to expand his empire and connect with others.

Dr. Creelman’s career in veterinary medicine came purely by chance based on a recommendation of a school mate who encouraged him to check out the work experience at his local vet clinic. He fell in love instantly. The smells, the chaos, the not knowing what to expect day-to-day fascinated Dr. Creelman so much that he decided, at the tender age of 16, to pursue a career in veterinary medicine.

Dr. Creelman attended the Western College of Veterinary Medicine (WCVM) and graduated in 2011. He became a beef cattle veterinarian and practice owner of Veterinary Agri-Health Services. Having a need to market his veterinary services, he decided to turn the camera on himself to show the human side of being a veterinarian.

The whole experience and the results really came as a surprise to Dr. Creelman. He never would have guessed he was a creative person and only discovered and tapped into his creativity when he was out in practice. “At the beginning of my digital escapades I just really wanted to tell the story of our veterinary clinic and me as a veterinarian and provide trust to prospective clientele,” Dr. Creelman explains. It wasn’t easy. It took hard work, trial and error, and learning how to tell a story that would connect with people on an emotional level. He wanted to show the landscapes, the environment, and the beauty of working with farmers. “The work environment and my passion for veterinary medicine spilled into the medium I was most comfortable with.”

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Dr. Creelman quickly grew a social media following, which in turn, helped build his clientele base. “In terms of business, I would have never guessed it, but it is an uplifting experience when your story is already known. Let’s say, for example, I’m going to be negotiating with a veterinarian who wants to “sell” me on their practice for the first time. It is a completely different situation when you walk into a conference room, and they already know you. They trust you as a veterinarian and as a human being. When you step out of your truck for the very first time on a farm, and the farm family greets you like an old friend, that’s….I don’t know how to recreate that any other way, and it’s such a huge positive upside for your relationship as a veterinarian if that client is trusting you on day one. That typical relationship takes years to develop. I never would have been able to have guessed that would have been an outcome, but there’s certainly that benefit of people trusting you before they meet you,” Dr. Creelman explained.

Continuing to grow his social media presence, being a veterinarian with multiple practices, starting a fashion line, being a husband and father hasn’t always been easy and Dr. Creelman doesn’t even know if he believes in the term balance. “We all have work and we all have life. I feel like it’s more like work-life juggling. There are times when my work life takes precedence over my family life, and there are times when my family life takes precedence over my work life. I never feel it’s balanced. And I think I have yet to meet someone who truly feels like there’s this yin and yang of their work. It’s always a sacrifice and you must prioritize every minute of every day. It’s hard for everybody. There’s a sacrifice for everyone”.

Providing mentorship to students is also a priority for Dr. Creelman. Take for example, this past January, when a student slid into his direct messages via Instagram if he was interested in being a keynote speaker during the 2020 Symposium, which took place at his alma mater, WCVM. “I certainly have a huge soft spot for veterinarian students in general. One of my greatest professional accomplishments is connecting with a lot of students. I love nothing more than going to a veterinary college and being able to speak to students and bestow a little bit of wisdom and connect with them and humanize veterinarians out in practice to show them that we are just regular normal people and we can have regular normal lives. Especially when they come from WCVM where I graduated it didn’t take too much convincing.”

Dr. Creelman believes in a strong sense of community and says that, “without that support and community, I wouldn’t have the strength to do the scary things that I do, including standing up and speaking at Symposium. Public speaking is a terrifying experience; however, when you know there’s a supportive

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As Dr. Creelman reflects on his time at WCVM he wants new veterinary students to know “I think the greatest failure a veterinary student experiences is not recognizing how much time is in their career. Just go out and do some crazy things. Make mistakes and have fun. That’s my biggest criticism of myself going through veterinary school and coming out is I was always rushing to the next step. I couldn’t wait to get into the practice of my dreams. I couldn’t wait to get into partnership. And now in retrospect, if you want to take 6 months off, then you should be able to do that. And just know that 40 years in this profession is a long time and you have all the time in the world to do what you want to do.”

community behind you that wants you to succeed, it gives you the power to try or at least have the confidence that somebody else believes in you”.

He can trace his desire to mentoring back to when he was pursuing his DVM. “I’ve always had what I call peripheral mentors. Never really one-on-one and call this one person my life mentor or guru, instead I’ve always had around me a sphere of people I draw different wisdoms from in order to help me along. The one that comes to mind is an animal science professor, Dr. Frank Robinson at the University of Alberta. And I feel like the most important thing Dr. Robinson did for me in terms of the role of being a mentor, which I always try to bestow upon my mentees, is believing in someone before they believe in themselves. It truly is what Dr. Robinson did for me.”
The Art of Private Veterinary Practice
L’art de la pratique vétérinaire privée

When what makes sense doesn’t

Myrna Milani

“Well, that was frustrating!” announces Dr. Hagendorf as she enters the office she shares with a new associate veterinarian. “Have you ever seen Roger Secour and his French bulldog, Marie?”

“Only once if she’s the Marie with chronic skin problems,” replied the practice’s latest addition.

“Indeed she is,” agrees Dr. Hagendorf. “Mr. Secour is a nice person and seems very concerned about Marie. He’s not like those clients who give me a blank look when I discuss their animals’ problems and the treatment necessary to help them. Instead, he seems fully engaged. He asks intelligent questions and asks me to repeat my answer or rephrase it if he doesn’t understand. When he does understand something, he tells me that too.”

“So what’s the problem?” asks the other practitioner. “He sounds like the perfect client to me!”

“The problem is that even though I feel confident that he gets what I’m telling him at the time, the next time I see him and Marie it’s obvious he didn’t,” explains Dr. Hagendorf. “And I don’t know what to do.”

When most practitioners think of noncompliant clients, they think of those whose verbal responses and body language signal that these clients are disengaged from the process. They are with the practitioner in the examination room or stall, but their minds are obviously somewhere else. Some of these clients periodically may sneak a peek at their watches or phones. Others may look around the examination room or out a window. Those in a third group may roll their eyes, stifle yawns, or otherwise signal their disinterest or boredom. If they have any questions — and often they do not — their queries tend to be few and superficial.

When Dr. Hagendorf first encountered such clients as a new practitioner, she devoted a fair amount of time attempting to get these clients more involved in the veterinary process. She also devoted a fair amount of time to ranting and raving to her colleagues about the negative effects these clients’ lack of compliance had on their animals’ health. However, once she became more familiar with the practice’s clients, she realized that many of them were not the animal’s primary caregiver. They just happened to live in the same household with that person or agreed to be present for the animal’s examination because the primary caregiver could not for some reason. Once the practitioner realized this, she made a note in the client’s record to follow up such appointments with a call to the primary caregiver to determine if that person had any questions about the animal’s condition or any prescribed treatments.

Compared to these clients, the Roger Secours in the client base appear to be exactly the opposite. This most likely explains why practitioners may feel so frustrated when subsequent visits make it clear that these clients have not cared for their animals as directed. Were they not listening when they acted like they were? Or were they listening, but for some reason not receiving the message the practitioners thought they were clearly communicating? Worse, the messages these clients were receiving from the veterinarian apparently made sense to them because they asked meaningful questions relevant to these. Consequently, these clients’ verbal and nonverbal communications were consistent with that of a client who interpreted the veterinarian’s message as sent. And this, in turn, caused the practitioner to assume that the client perceived the animal’s condition and any treatment for it the same way the veterinarian did…until the next appointment or phone call when it becomes clear the client has not.

For as inexplicable as these cases appear to be, such breakdowns in communication arise from the different perspectives of the veterinarian and the client. Dr. Hagendorf’s message is one that reflects her problem-oriented approach to Marie’s skin problem and its treatment. Mr. Secour listens to this attentively and even asks meaningful questions at times. He fully agrees with the veterinarian’s view of the problem and its treatment and has no questions about it. However, he also knows that the circumstances in his household are such that implementing that treatment may be easier some days than others.

Whereas inexperienced practitioners may be tempted to huff, “Well, if these clients really valued their animals they’d find some
way to treat their animals properly!” more experienced ones acknowledge that the same might be said of practitioners who do not know their clients very well.

For example, Dr. Hagendorf works in a large, multi-practitioner practice located in a bedroom community of a large metropolitan area. At the same time though, many community properties are large enough to attract horse-lovers and those seeking to establish very small holdings with a variety of livestock. Thanks to the miracle of technology, clients who request an appointment may or may not see the same clinician they have seen before. From the clinicians’ perspective, this poses no problem because the practitioners all have access to each client’s record. Thus, although individual clinicians came and went in the years since the system was installed, theoretically this did not interfere with quality practitioner-client communication. However, a different perspective emerges when Dr. Hagendorf runs into the garrulous now-retired veterinarian, Dr. DiLuzio, who had founded the practice more than 5 decades previously. When she mentions Mr. Secour because she knows he lives near Dr. DiLuzio, Dr. DiLuzio exclaims, “Now there’s a sad case!”

Dr. DiLuzio goes on to explain that Roger Secour’s mother suffers from dementia and lives with Mr. Secour, his wife, their 3 children, and their dog Marie. As often occurs in these situations, his mother has good days and bad ones. Because only the dog seems to stabilize his mother on her bad days, Mr. Secour and his wife are reluctant to separate the dog from his mother on those days she clings to the animal for comfort.

“Oh, I’m so sorry to hear that! If only he’d told me, I would have understood,” replies the younger veterinarian. But even as Dr. Hagendorf says this, she knows that the reserved Mr. Secour would not have volunteered this information. Dr. DiLuzio admitted that he would not have known either, had he not been a part of this community for his entire life. However, by this “community,” he meant the area he grew up in and to which he returned to start a practice after he graduated from veterinary school. Since then, that farming community has morphed into a suburban and urban center in a remarkably short time. This occurred thanks to an influx of corporations and a community college that grew into a well-respected residential one. And like the large multi-veterinarian facility that ultimately replaced Dr. DiLuzio’s small practice, access to increasingly sophisticated communication technology made this rapid rate of change possible.

Although Dr. DiLuzio did not long for the good old days, he also acknowledged that the increased pace and fluidity of the current practice, and society in general, could make quality communication between practitioners and their clients more difficult. Until his retirement, he was the only veterinary practitioner Roger Secour and his parents had known. During that time, they had come to know each other well. As the practice grew and began adding other veterinarians, Dr. DiLuzio strove to maintain those closer relationships. But when he retired, that established clinician-client connection and the trust that went with it was lost. Nor did the current scheduling system foster the formation of such relationships.

“But that’s not necessarily a bad thing,” Dr. DiLuzio assured the younger veterinarian. “Because there’s nothing in Marie’s record to tell you what I knew from my personal relationship with the Secours, there’s no reason why you can’t ask Roger if there’s any reason why Marie might not be receiving her medicated baths and other medications as directed. When you broach the subject like that and with the idea of giving him alternatives that address those issues, I’m sure he’ll be more forthcoming.”

The context in which practitioners communicate with clients and clients receive this input always will be different in one way or another. And if the practitioner’s and client’s respective orientations do not interfere with quality care for the animal, it does not matter. In situations in which these differences do interfere with the animal’s treatment and health, learning more about the interactions between the animal, the client, and others in the household may affect the practitioner’s recommendations and the animal’s treatment which becomes a viable and even necessary option to consider. Will any work or family obligations interfere with the client’s ability to medicate the animal as directed? Does the nature of the bond between the client or others in the household support the treatment as prescribed by the practitioner? Is it possible for clients to fully comprehend and agree with any treatments their veterinarians prescribed for their animals. However, a gap may exist between that comprehension and successful implementation of those treatments at home.
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