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Registered Veterinary Nurse?  
Infirmier vétérinaire autorisé?

What's in a name? In the United States there is a campaign being waged by the National Association of Veterinary Technicians of America (NAVTA) to change the veterinary technician titles to “registered veterinary nurse” (RVN). This Veterinary Nurse Initiative (VNI) is proceeding by seeking to have legislation passed in various states to give legal status to the title registered veterinary nurse (1). Tennessee and Ohio were the initial states in which the effort was launched. In Tennessee the move met strong opposition from human nurses whose lobbying is credited with preventing the bill from passing. A petition from the nurses argued that “Just as ‘animal doctors’ are called veterinarians, not physicians, ‘animal nurses’ should be called something other than nurses.” In Ohio the bill was strongly supported at the House committee stage but it did not get to the legislature before recess (1). Here too there was strong opposition from the state nurse association. In late January of this year Indiana passed the RVN bill through their State Senate Committee but it must pass in the legislature to be effective.

The position of the National Association of Veterinary Technicians of America (NAVTA) is that a single title should replace the various titles used in different states to refer to veterinary technicians and that registered veterinary nurse is an appropriate replacement title (2). At present, veterinary technicians in the United States are referred to as Certified Veterinary Technician (CVT), Licensed Veterinary Technician (LVT) or Registered Veterinary Technician (RVT). NAVTA is also proposing uniform requirements for credentials and scope of practice. The problem appears to be the enormous variation from state to state in terminology and regulations related to veterinary technicians. NAVTA recognizes that the changes that are needed will take time and they speak of a 5- to 10-year period to effect these changes. The major hurdle for the initiative is the new name that has been proposed.

The term veterinary nurse has been in use for decades in several countries. In the UK, the Royal College of Veterinary Surgeons (RCVS) approved the first Animal Nursing Auxiliary
training scheme in 1961 and the British Veterinary Nursing Association was formed in 1965. In New Zealand, formal organization of veterinary nurses occurred in 1992 and in Australia the Veterinary Nurses Council was established in 1995. In the European Union (EU), The Accreditation Committee for Veterinary Nurse Education was founded in 2007 to accredit veterinary nurse education programs in the EU and there are now more than 70 accredited programs from 7 EU countries. It is interesting that in the UK the title veterinary nurse, despite its general use for over 50 years, does not have legislative protection. In 2015, the RCVS submitted a petition to the government seeking protection of the title “veterinary nurse.” The concern was that, because the title is not protected under the law, individuals lacking appropriate training and education could use the title veterinary nurse. Despite the petition having more than 36 000 signatures the government declined to give the requested legal protection.

Are Registered Veterinary Technicians nurses or technicians? Technician is defined as "a person employed to look after technical equipment or do practical work in a laboratory" or "a worker in a field of technology who is proficient in the relevant skill and technique." A nurse is defined as "a person trained to care for the sick or infirm, especially in a hospital." The term nurse emphasizes the caring aspect of the work, which is a critical component of the work of RVTs. It seems to me that veterinary technicians are both technicians and nurses and this is reflected in the titles in use in North America and the UK.

In Canada, there is a distinct, nationally recognized title — Registered Veterinary Technician/Technologist (RVT). The Registered Veterinary Technicians and Technologists of Canada (RVTTTC) have determined that their focus should not be on attempting to change the title of veterinary technicians/technologists but rather it should be on educating the public on the work done by RVTs (3).

RVTs are a critically important part of the veterinary practice team and the task of ensuring that they receive the respect and recognition they are due is one which veterinarians are eager to support. This support is shown not only at the individual clinic level but also at the levels of provincial and national veterinary associations. I salute the RVTs for their technical skills, their passion for animal care, and their focus on seeking a better understanding of the work they do.

References

Carlton Gyles

(Opinions expressed in this column are those of the Editor)
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5 WAYS YOU CAN TALK TO YOUR CLIENTS ABOUT PET INSURANCE AND GROW YOUR PRACTICE

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With so many pet insurance companies to choose from, finding an insurance company that you support can be tricky. Make sure you have an understanding about how pet insurance works before talking about it with your client. Chances are, there are different conditions that may or may not be covered. Your best course of action is always to direct your client to an experienced insurance advisor, so they’ll know exactly what their pet will be covered for. Choose to work with a pet insurance company that has experience in the business with an expert team to provide support.

2. EDUCATE YOUR STAFF ABOUT PET INSURANCE

You’re not a salesperson. But, the importance of communicating the health benefits about pet insurance can be a win for your practice, your staff, and your clients. When it’s been a busy day and your team is running around, it could be helpful to have at least one person on staff who’s knowledgeable about pet insurance.

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3. **WHEN YOUR CLIENT ASKS IF IT’S WORTH IT**

In short, pet insurance is priceless. But, the truth is, pet insurance can come across as confusing. If your clients ask, let them know that pet insurance is meant to offer peace of mind for unexpected accidents or illnesses that might come up. If they want to know specific details, it’s best to direct them to an insurance advisor who can offer a deeper understanding about pet insurance and help your client find a plan that works for their budget.

4. **OFFER A HIGH-LEVEL OVERVIEW OF HOW PET INSURANCE WORKS**

Let’s face it, pets are unpredictable. If your client’s dog or cat suddenly gets sick, pet insurance can help cover the cost of the medical treatments he or she might need. Pet insurance can help cover things like diagnostic services, X-rays, surgeries, overnight hospital stays, and more. Plus, it can help cover the cost of the medication that the veterinarian prescribes to treat the illness or condition, exam fees, and taxes.

5. **UPDATE YOUR WEBSITE**

It helps to have up-to-date information about payment and pricing on your website in case your clients have questions about payment solutions. If a client calls your clinic to chat about pet insurance, refer them to an experienced insurance advisor who can talk with them about the ins and outs of coverage, so they’ll know exactly what their pet is covered for.

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Renvois


Carlton Gyles

(Les opinions exprimées dans cette rubrique sont celles du rédacteur en chef)
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An ethicist’s commentary on reductive animal studies relevant to knowing animal welfare?

From the time that I was a child, I have experienced great concern for animals and their well-being. And, as my readers know, I have devoted the last 40+ years to attempting to improve animal welfare. I have fortunately been fairly successful, from passing United States federal legislation requiring control of pain in animals used in invasive research after proving to Congress that no pain control was utilized; to expediting the elimination of brutal laboratory exercises for veterinary students; to convincing Smithfield Farms to eliminate gestation crates; to creating courses in laboratory animal welfare; to creating the first course in ethical issues in confinement agriculture.

For my entire career, I have had a great interest in the issue of animal consciousness and its knowability. My 1989 book, The Unheeded Cry: Animal Consciousness, Animal Pain, and Science (1), exposed the degree to which the scientific community was agnostic about animal consciousness. It always seemed to me, and still does, that there is very little as obvious to common sense, as Darwin professed, than that animals possess thought and feeling.

But from the time I enrolled in college, until now, I had great difficulty finding anyone willing to talk in a straightforward manner about animal mind. As I wrote in The Unheeded Cry, one of the few common beliefs shared by both behaviorists and European ethologists was a denial of the knowability of animal consciousness. This struck me as exceedingly bizarre, since in my mind the essence of animal welfare was essentially the experience of the animal.

JB Watson, the “father of behaviorism,” declared that he “did not care about consciousness.” That was predictable. What was far more surprising was the fact that European ethologists in the tradition of Lorenz and Tinbergen were “just as susceptible to scientific ideology, just as anxious to demonstrate their fealty to it, which meant either denying or ignoring questions of subjective experience.” (The Unheeded Cry, pp. 211–212). In a book
recounting the first joint conference between behaviorists and ethologists, Tinbergen was crystal clear on this point (2):

“[both behaviorism and ethology] are fundamentally the same in that both have as their object an observable phe-

omenon, in that they are both ‘objective.’ Both schools study behavior, and not a mysterious ‘psyche’, nor unob-
servable subjective phenomena.”

Thus, virtually no mainstream animal behaviorists studied consciousness. And herein lies the rub. If we really wish to
understand animal well-being, we must of necessity allude to the animal subjective state, precisely as we do in humans. The
reductive methodology described in this case is a direct result of ideological scientism, where the animal’s mental state drops out
of discussion. The sort of narrowly defined studies illustrated by reference to different litter substrates for dust bathing, illumini-
ate animal welfare only in reference to the animal’s experience. Talking about the animal’s welfare presupposes not only an
absence of pain and distress, but also the animal’s actualization of the physical and psychological needs dictated by the animal’s
nature, what Aristotle called its telos, and its consciousness thereof. If an animal had no conscious experience, it would be
absurd to talk about it being in a state of positive welfare!

To talk, then, about good welfare in an animal, one must look
at the sum of its experiences — its ability to move (missing in
sows in crates, hens in battery cages, tethered veal calves), as
well as its ability to be with others of its own kind if it has a
social nature, as well as numerous other parameters. No doubt
the sort of reductive study enumerated in this case sheds some
light on the animal’s welfare, but only in the context of other
basic needs being met. For this reason, I consider the sort of
atomistic studies alluded to not terribly relevant to the “quality
of life of animals on commercial farms.” One must carefully
judge all aspects of the animal’s life in terms of its nature to get
a true picture of its welfare. This is the true import of this case.
As Alfred Lord Tennyson sagely wrote, “we murder to dissect.”
There is a good deal of sense in talking about the animal’s life
beyond the indefinite number of components that it can be
analyzed into. The study of animal welfare, like the study of
human welfare, would do well to keep this point in mind.

Bernard E. Rollin, PhD

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2. Schiller CH, ed. Instinctive Behavior: The Development of a Modern

Ethical question of the month —
June 2019

In Canada, federal law requires that animals are rendered
unconscious prior to exsanguination. This ensures Canadian
consumers that livestock are slaughtered according to certain
standards of humane treatment. Some slaughter facilities that
produce products for specific cultural markets are exempt from
this requirement. In these facilities animals are slaughtered using
a “non-stun” method. Occasionally, product from non-stun
slaughter facilities fails to meet cultural standards or demand
for parts of the carcass may be insufficient within that market.
In such cases, excess product is sold through standard marketing
channels. This results in consumers unknowingly purchasing
meat products that are produced contrary to their personal ethic
with regard to animal welfare. Should it be a requirement that
meat produced using a non-stun method be labelled as non-
stun when it is sold in the conventional market?

Submitted by Megan Allore, Fergus, Ontario

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,
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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.

Question déontologique du mois —
Juin 2019

Au Canada, la loi fédérale exige que les animaux soient rendus
inconscients avant l’exsanguination. Cela permet de garantir
aux consommateurs canadiens que le bétail est abattu selon
certaines normes de traitement non cruel. Certaines installations
d’abattage qui produisent des produits pour des marchés
culturels spécifiques sont exemptées de cette exigence. Dans
ces installations, les animaux sont abattus en utilisant une
método dans le marché peut être insuffisante pour certaines
parties de la carcasse. Dans ces cas, le produit excédentaire est
vendu par l’entremise des réseaux commerciaux standards, ce
qui a pour résultat que les consommateurs achètent à leur insu
des produits de viande qui sont transformés d’une manière
contraire à leur éthique personnelle en matière de bien-être des
animaux. Devrait-il y avoir une exigence d’étiqueter la viande
produite selon une méthode sans assommage pour informer
les consommateurs de ce fait lorsque cette viande est vendue
sur le marché conventionnel?

Soumise par Megan Allore, Fergus (Ontario)

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
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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,
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des personnes en cause.
1. Which of the following is the term for the ultrasound artifact that results in the liver appearing to be on both the thoracic and abdominal sides of the diaphragm?
   A. Distal acoustic shadowing
   B. Through transmission
   C. Attenuation
   D. Mirror image
   E. Slice thickness

2. The antithyroid drug methimazole has several common side effects in cats. Which of the following is NOT a common reported side effect?
   A. Seizures
   B. Neutropenia
   C. Hepatopathy
   D. Facial excoriation
   E. Thrombocytopenia

3. Concerning dilated cardiomyopathy, which of the following statements is LEAST accurate?
   A. Dilated cardiomyopathy is diagnosed via electrocardiography.
   B. Portuguese water dogs have a juvenile onset.
   C. It is caused by taurine deficiency in cats.
   D. It is associated with ventricular dilation and reduced ventricular function.
   E. Dilated cardiomyopathy can occur following the administration of toxic doses of adriamycin.

4. Which of the following is the most common clinical sign of pars intermedia dysfunction (PID) in horses?
   A. Laminitis
   B. Polyuria/polydipsia
   C. Hyperhidrosis
   D. Hirsutism
5. A 700-kg cow is lame in both hind digits, can barely walk, and prefers to remain recumbent in a straw-bedded stall. Which of the following methods will facilitate safe and effective field examination?

A. Walk the cow into a mechanized chute for limb restraint.
B. Have the cow stand in the stall with head and limb restrained.
C. Place the cow in lateral recumbency after xylazine administration.
D. Place the cow in lateral recumbency after flunixin administration.
E. Place the cow in dorsal recumbency after xylazine administration.

(See p. 600 for answers./Voir les réponses à la page 600.)
Meet Some of Canada’s Honored Veterinary Teachers!

Rencontrez quelques-uns des enseignants vétérinaires lauréats du Canada!

The CVMA Teacher of the Year Award is presented annually to a teacher at each of the Canadian veterinary colleges. The recipient, selected by veterinary students, is a teacher who inspired them most by their approach to the subject, teaching methods and enthusiasm.

Below are the 2018 CVMA Teacher of the Year Award Recipients:

**Dr. Bertrand Lussier**, professor of surgery at the Université de Montréal — Faculté de médecine vétérinaire (FMV), obtained his DVM from FMV in 1986. After 3 years in private practice and obtaining a Master of Science degree in Clinical Sciences, he completed his residency in Small Animal Surgery at Cornell University’s College of Veterinary Medicine in 1994 and obtained his board certification from the American College of Veterinary Surgeons in 1997. After several years as a private practice surgeon, Dr. Lussier went back to the University of Montreal in 1999, but this time as an assistant professor of surgery, becoming full professor of surgery in 2012. He is also involved in promoting surgical knowledge and expertise abroad with a yearly commitment to the Association Marocaine Des Vétérinaires Pour Animaux de Compagnie. As a veterinary surgeon, Dr. Lussier’s surgical expertise is vast (orthopedics, neurosurgery, soft tissue surgery, microsurgery) and his research interests include osteoarthritis (pain and function), the surgical correction and evaluation of the ruptured cranial cruciate ligament of the canine stifle and the development and validation of personalized 3D printed endoprostheses for canine limb sparing of the distal radius. He has also acquired expertise in the development, validation and application of animal models. Dr. Lussier has been honored with 10 awards of excellence in teaching, clinical teaching and research. One piece of advice from Dr. Lussier for veterinary students and new graduates is, “The students we teach and train today are so well equipped; however they must not forget to use the tools and skills we have provided them with!”

**Dr. Marina Leis**, an ophthalmology assistant professor in the Department of Small Animal Clinical Sciences at the Western College of Veterinary Medicine (WCVM), obtained her Doctor of Veterinary Medicine from WCVM in 2012 where she also completed a 1-year small animal rotating internship and a 3-year American College of Veterinary Ophthalmologists residency. In 2016, Dr. Leis was appointed assistant professor in the Department of Small Animal Clinical Sciences at the University of Saskatchewan. During her veterinary program, Dr. Leis

Le Prix de l’enseignant de l’année de l’ACMV est décerné annuellement à un enseignant dans chacune des écoles de médecine vétérinaire canadiennes. Les récipiendaires, qui sont choisis par les étudiants en médecine vétérinaire, sont des enseignants qui ont le plus inspiré les étudiants par leur approche envers la matière, leurs méthodes d’enseignement et leur enthousiasme.

Voici les récipiendaires du Prix de l’enseignant de l’année de l’ACMV pour 2018 :

La Dre Bertrand Lussier, professeure de chirurgie à la Faculté de médecine vétérinaire (FMV) de l’Université de Montréal, a obtenu son D.M.V. à la FMV en 1986. Après avoir passé trois années en pratique privée et avoir obtenu une maîtrise en sciences cliniques, il a suivi une résidence en chirurgie des petits animaux au Collège de médecine vétérinaire de l’Université Cornell en 1994 et a obtenu l’agrément de l’American College of Veterinary Surgeons en 1997. Après plusieurs années en tant que chirurgien en pratique privée, le Dr Lussier est retourné à l’Université de Montréal en 1999, mais cette fois comme professeur adjoint de chirurgie et il a accédé au rang de professeur agrégé de chirurgie en 2012. Il participe aussi à la promotion des connaissances et de l’expertise en chirurgie à l’international dans le cadre d’un engagement annuel auprès de l’Association marocaine des vétérinaires pour animaux de compagnie. À titre de chirurgien vétérinaire, le Dr Lussier possède une vaste expertise chirurgicale (orthopédie, neurochirurgie, chirurgie des tissus mous, microchirurgie) et ses intérêts de recherche incluent l’ostéo-arthrite (douleur et fonction), la correction chirurgicale et l’évaluation de la rupture du ligament croisé crânial du grasset canin et le développement et la validation d’endoprothèses personnalisées imprimées en 3D pour les membres canins afin d’épargner le radius distal. Il a aussi développé une expertise dans le développement, la validation et l’application des modèles animaux. Le Dr Lussier a été récompensé par 10 prix d’excellence en enseignement, en enseignement clinique et en recherche. Un conseil souvent communiqué par le Dr Lussier aux étudiants en médecine vétérinaire et aux finissants est le suivant : « Les étudiants auxquels nous enseignons aujourd’hui et qui suivent une formation sont vraiment bien outillés, cependant, ils ne doivent pas oublier d’utiliser les outils et les compétences que nous leur avons transmis! »

La Dre Marina Leis, professeure adjointe d’ophtalmologie au Département des sciences cliniques pour petits animaux du Western College of Veterinary Medicine (WCVM), a obtenu son doctorat en médecine vétérinaire auprès du WCVM en 2012 où elle a aussi suivi un internat de rotations d’un an en médecine des petits animaux et une résidence de trois ans de l’American College of Veterinary Ophthalmologists. En 2016, la Dre Leis a été nommé professeure adjointe au Département des sciences cliniques pour petits animaux de l’Université de la Saskatchewan.
worked as a WCVM small animal research student and as a student clinical employee at the WCVM Veterinary Medical Centre. Dr. Leis advises veterinary students and new grads that “veterinary medicine is a career of lifelong learning so it’s key to stay current and practice evidence-based medicine.”

Dr. Alexa Bersenas has been an Ontario Veterinary College (OVC) faculty member since 2004 and is currently an associate professor in Clinical Studies and was the chief of the Emergency & Critical Care Services at the OVC Health Sciences Centre from 2008 until her current sabbatical. Dr. Bersenas graduated from OVC and subsequently completed a 1-year small animal rotating internship at the Atlantic Veterinary College. After, she practiced small animal medicine in Toronto for 2 years before returning to OVC where she completed a residency in Emergency & Critical Care and a concurrent Masters in Science between 2001 and 2004. Dr. Bersenas is interested in respiratory and renal diseases, as well as feline medicine, analgesia and the provision of exceptional nursing care. In 2014, Dr. Bersenas initiated veterinary dialysis in Canada for patients with acute kidney injury. In addition to patient care, Dr. Bersenas enjoys undergraduate and graduate teaching, active participation in continuing education and if she could give veterinary students one piece of advice it would be to “find a career in veterinary medicine that keeps you thrilled with the profession and feeling like it is more of a hobby or labor of love.”

Dr. Søren Boysen, full professor of Small Animal Emergency and Critical Care at the University of Calgary — Faculty of Veterinary Medicine (UCVM), obtained his veterinary degree from the Western College of Veterinary Medicine in 1996. After, Dr. Boysen completed a small animal internship at the Atlantic Veterinary College in 1998 and a residency in 2003 at Tufts University in Massachusetts, becoming a diplomat of the American College of Veterinary Emergency and Critical Care that same year. He is the former chief of Small Animal Emergency and Critical Care (ECC) at the University of Montreal, and loves all things ECC, particularly point of care ultrasound, lactate, coagulation and perfusion (just ask his students). That said, Dr. Boysen’s true passion and reason for being in academia is teaching. He loves being in the classroom, lab or clinics with students and loves to teach veterinarians at continuing education events around the world. “Remember that veterinary medicine, like life, has many opportunities,” advises Dr. Boysen. “Seek the things that drive you and that you are most passionate about, and above all, try to have fun along the way!” When not working Dr. Boysen enjoys spending time with his family, hanging with his 2 furry felids (Pip and Maddy), the back-country, and European Football (go Spurs)!

Dr. Oriana Raab, assistant professor of Small Animal Internal Medicine at the Atlantic Veterinary College (AVC), attended St. George’s University School of Veterinary Medicine (SGUSVM), completed her clinical year at North Carolina Internal Medicine at the University of Calgary — Faculty of Veterinary Medicine (UCVM), obtained his veterinary degree from the Western College of Veterinary Medicine in 1996. After, Dr. Boysen completed a small animal internship at the Atlantic Veterinary College in 1998 and a residency in 2003 at Tufts University in Massachusetts, becoming a diplomat of the American College of Veterinary Emergency and Critical Care that same year. He is the former chief of Small Animal Emergency and Critical Care (ECC) at the University of Montreal, and loves all things ECC, particularly point of care ultrasound, lactate, coagulation and perfusion (just ask his students). That said, Dr. Boysen’s true passion and reason for being in academia is teaching. He loves being in the classroom, lab or clinics with students and loves to teach veterinarians at continuing education events around the world. “Remember that veterinary medicine, like life, has many opportunities,” advises Dr. Boysen. “Seek the things that drive you and that you are most passionate about, and above all, try to have fun along the way!” When not working Dr. Boysen enjoys spending time with his family, hanging with his 2 furry felids (Pip and Maddy), the back-country, and European Football (go Spurs)!

Dr. Oriana Raab, assistant professor of Small Animal Internal Medicine at the Atlantic Veterinary College (AVC), attended St. George’s University School of Veterinary Medicine (SGUSVM), completed her clinical year at North Carolina
State University and received her Doctor of Veterinary Medicine from SGUSVM in 2007. Following graduation, Dr. Raab completed a 1-year small animal rotating internship at Washington State University, as well as a 2nd rotating internship at a private practice in New York. In 2009, Dr. Raab moved to Prince Edward Island where she completed a combined small animal internal medicine residency and Master of Veterinary Science program at AVC. After her residency, Dr. Raab worked for 2 years at Tufts Veterinary Emergency and Treatment Specialties prior to returning to AVC to join the faculty and also serve as coordinator and primary veterinarian for AVC’s wildlife service. Dr. Raab has authored several articles published in The Canadian Veterinary Journal as well as chapters in the Clinical Veterinary Advisor and The Textbook of Veterinary Internal Medicine. Dr. Raab has also received several teaching awards including class appreciation and mentor awards from the AVC graduating classes of 2011 and 2012 and believes that learning is a lifelong process. “Find a path in veterinary medicine that fascinates you and immerse yourself in it,” Dr. Raab tells students and new graduates. “Always do your best, but remember that no one has all the answers and expecting perfection from yourself is unrealistic and will often lead to unhappiness. When you encounter difficult times, remember why you chose veterinary medicine, never lose sight of your passion and try to have fun along the way!”

St. George's (SGUSVM), elle a réalisé son année clinique à l'Université d'État de la Caroline du Nord et a obtenu son doctorat en médecine vétérinaire à SGUSVM en 2007. Après la fin des études, la Dʳ Raab a suivi un internat de rotations en médecine des petits animaux à l'Université d'État de Washington ainsi qu'un deuxième internat de rotations dans une pratique privée de New York. En 2009, la Dʳ Raab est déménagée à l’Île-du-Prince-Édouard où elle a suivi un programme combiné de résidence en médecine interne des petits animaux et de maîtrise en sciences vétérinaires à l’AVC. Après sa résidence, la Dʳ Raab a travaillé pendant deux ans à Tufts Veterinary Emergency and Treatment Specialties avant de retourner à l’AVC pour se joindre au corps professoral et aussi à titre de coordonnatrice et vétérinaire principale du service de la faune de l’AVC. La Dʳ Raab a rédigé plusieurs articles publiés dans La Revue vétérinaire canadienne ainsi que des chapitres dans le Clinical Veterinary Advisor et l’ouvrage The Textbook of Veterinary Internal Medicine. La Dʳ Raab a aussi reçu plusieurs prix d’enseignement, dont les prix d’appréciation et de mentor des promotions finissantes de 2011 et de 2012 de l’AVC et elle croit que l’apprentissage est un processus de toute une vie. «Trouvez un parcours qui vous fascine en médecine vétérinaire et plongez à fond», dit la Dʳ Raab à ses étudiants et aux finissants. «Donnez toujours le meilleur de vous-même, mais rappelez-vous que personne ne possède toutes les réponses et qu’il n’est pas réalisiste de s’attendre à toujours atteindre la perfection et que cela entraîne l’insatisfaction. Lorsque vous vivez des moments difficiles, rappelez-vous pourquoi vous avez choisi la médecine vétérinaire, gardez le cap sur votre passion et essayez de vous amuser pendant le parcours!»

**Council Update**

The Canadian Veterinary Medical Association (CVMA) is the national and international voice for Canada’s veterinarians, providing leadership and advocacy for veterinary medicine. Our **priorities** are:

- Leadership on national veterinary issues
- Animal welfare advocacy
- A successful career, a balanced life

**Strategic Planning**

During the March Council meeting and Committee Weekend, a strategic planning session was held to discuss a membership survey that was carried out in the fall of 2018. As part of its ongoing commitment to its members, CVMA Council wanted to

**Mise à jour du Conseil**

L’Association canadienne des médecins vétérinaires (ACMV) est la voix nationale et internationale des médecins vétérinaires du Canada et elle assure le leadership et la défense des intérêts de la médecine vétérinaire. Voici nos **priorités** :

- Leadership à l’égard des enjeux nationaux
- Défense du bien-être animal
- Une carrière prospère, une vie équilibrée

**Planification stratégique**

Durant la réunion du Conseil de mars et la fin de semaine des comités, une séance de planification stratégique s’est déroulée pour discuter d’un sondage auprès des membres qui a été réalisé à l’automne 2018. Dans le cadre de son engagement envers ses membres, le Conseil de l’ACMV désirait s’assurer qu’il offrait la valeur auquel s’attendaient les membres. Le Conseil a conclu qu’il était nécessaire de comprendre la satisfaction des membres et leurs besoins. Pour se rendre compte de cette situation, l’ACMV a entrepris un sondage qualitatif auprès des membres et des non-membres dans le cadre d’entrevues téléphoniques et d’un sondage quantitatif en ligne auprès des membres, des étudiants et des non-membres. Le but de cette étude consistait à comprendre les sentiments des membres à propos de l’ACMV, ce qui peut
make sure it was delivering the value expected from membership. Council concluded that an understanding of member satisfaction and their needs was necessary. To gain this understanding, the CVMA undertook a qualitative member and non-member survey through telephone interviews and an online quantitative survey with members, students and non-members. The purpose of the study was to gain insight into how members feel about the CVMA, what it has accomplished and what its priorities and direction should be in the future. The consultants also compared results with a significant number of other professional associations.

**Highlights**

When asked how satisfied members are with the CVMA, the *satisfaction score* was in the “very satisfied” category, with a score higher than the average the consulting firm has seen across 48 studies with professional associations.

A high point was shown in the rating of CVMA’s *services*. While there are some potential issues around penetration of services in some areas, members who use them tend to be “very satisfied.”

While lower than other benchmarks, *representation* still rated a “reasonably good” score; that being the case, the CVMA’s score was the 2nd highest among the cohort of the comparative associations. This demonstrates that in professional associations, members set a very high standard for “representation.”

The CVMA’s effectiveness at *communicating* to members rated “reasonably well.”

The CVMA will analyze the 65-page report and address the valuable input provided by our members; members can expect changes in many areas.

**Other Council business**

**Animal Welfare**

*Animal Cruelty Act*: To represent the views of veterinarians, the CVMA appeared before the House of Commons’ Standing Committee on Justice and Human Rights with respect to its hearing on Bill C-84, An Act to amend the Criminal Code (bestiality and animal fighting).

*Castration of Cattle, Sheep and Goats*: Council approved the following revised position statement:

> “The Canadian Veterinary Medical Association (CVMA) recommends that when castration of cattle, sheep, or goats is required, an appropriate technique with anesthesia and analgesia is used and that it is undertaken at a young age.”

*Electroejaculation of Ruminants*: Council approved the following revised position statement:

> “The Canadian Veterinary Medical Association (CVMA) considers that the electroejaculation of ruminants is a veterinary procedure. Veterinary skills are required to examine the suitability of the animal prior to the procedure and to ensure optimal: analgesia, restraint of the animal, selection and operation of the equipment and monitoring of the responses of the animal to minimize any discomfort associated with electroejaculation.”

*Pain Management*: The Animal Welfare Committee has identified that the CVMA needs a framework to ensure that there is consistency in how CVMA references and discusses pain, including definitions, strategies, priority activities and

**Faits saillants**

Lorsque l’on a interrogé les membres à propos de leur niveau de satisfaction à l’égard de l’ACMV, la *note de satisfaction* se situait dans la catégorie «très satisfait», avec une note supérieure à la moyenne observée par l’entreprise de consultants au cours de 48 études auprès d’associations professionnelles.

Un moment fort a été l’évaluation des *services* de l’ACMV. Même s’il existe certains enjeux potentiels liés à la pénétration des services dans certaines régions, les membres qui s’en servent ont tendance à être «très satisfaits».

Même si elle a obtenu une note inférieure aux autres éléments évalués, la *représentation* a tout de même obtenu une note de «raisonnablement bonne» et cette note de l’ACMV représentait la deuxième plus élevée parmi une cohorte d’associations comparatives. Cela démontre que, dans les associations professionnelles, les membres établissent des critères très élevés pour la «représentation».

L’efficacité de l’ACMV au niveau de la *communication* avec ses membres a été cotée comme étant «raisonnablement bonne».

L’ACMV analysera le rapport de 65 pages et abordera la précieuse rétroaction fournie par nos membres et ils pourront s’attendre à des changements dans de nombreux domaines.

**Autres affaires du Conseil**

**Bien-être animal**

*Loi sur la cruauté envers les animaux*: Pour représenter les points de vue des médecins vétérinaires, l’ACMV a comparu devant le Comité permanent de la justice et des droits de la personne de la Chambre des communes concernant le projet de loi C-84, Loi modifiant le Code criminel (bestialité et combats d’animaux).

*Castration du bétail, des moutons et des chèvres*: Le Conseil a approuvé la révision de l’énoncé de position suivant :

> «L’Association canadienne des médecins vétérinaires (ACVM) recommande que, lorsque la castration des bovins, des moutons ou des chèvres est requise, elle devrait être réalisée au plus jeune âge possible en utilisant de l’anesthésie et de l’analgésie ainsi qu’une technique appropriée.»

*Electro-éjaculation des ruminants*: Le Conseil a approuvé la révision de l’énoncé de position suivant :

> «L’Association canadienne des médecins vétérinaires (ACVM) considère que l’électro-éjaculation des ruminants est une intervention vétérinaire. Des compétences vétérinaires sont requises pour examiner l’aptitude de l’animal avant l’intervention, optimiser l’analgésie, la rétention de l’animal, la sélection et le fonctionnement de l’équipement et la surveillance des réactions de l’animal ainsi que minimiser l’inconfort associé à l’électro-éjaculation.»

*Gestion de la douleur*: Le Comité sur le bien-être animal a identifié que l’ACVM a besoin d’un cadre de travail afin d’assurer de l’uniformité dans la façon dont l’ACVM mentionne la douleur et en discute, notamment des définitions, des stratégies, des activités et des actions prioritaires, la reconnaissance de nouvelles approches et de la recherche dans les domaines comme la douleur chronique et la douleur psychologique chez les animaux et les nouvelles modalités de traitement. Le plan actuel comprend l’examen et
actions, recognition of new thinking and research in areas such as
chronic pain and psychological pain in animals, new modalities
of treatment. The current plan includes review and revision of
now-outdated pain posters for both small and large animals, sev-
eral new position statements on pain, articles for *The Canadian
Veterinary Journal (The CVJ)* and communication initiatives.

**National Issues**

**Advocacy:** The CVMA appeared before the House of Commons
Standing Committee on Agriculture and Agri-Food on the
matter of Perception of and Public Trust in the Canadian
Agricultural Sector.

**Antimicrobial Use (AMU) Stewardship:** The CVMA has
been supporting veterinarians in the ongoing transition to
the new Health Canada veterinary antimicrobial use policies
(medically important antimicrobials are now prescription only)
and regulations. Examples are the continued development of
its website with links to collaborators and stakeholders such as
the Animal Nutrition Association of Canada, Canadian Animal
Health Institute, and the Veterinary Drugs Directorate of Health
Canada. The CVMA convened a meeting with The Canadian
Animal Health Products Regulatory Advisory Committee to
develop veterinary outreach communications.

The CVMA Guidelines for prudent use of antimicrobials
were revised, extended to 6 species (including small animals) and
released on November 30, 2018. The next step in this project is
to fine tune the new online prudent use guidelines and to add
aquaculture and equine guidelines. Furthermore, this project (for
which federal funding has been proposed) will include a pilot
project on surveillance of antimicrobial use within a limited
group of food animal practitioners; communications activities
to increase awareness and transfer knowledge and best practices
on antimicrobial stewardship to veterinarians and public; and
resources to support and promote alternatives to AMU.

**Vaccination of Animals:** Council approved the following
revised position statement:

“The Canadian Veterinary Medical Association (CVMA) sup-
ports the use of vaccines by veterinarians to control and prevent
infectious disease in animals, including domestic animals, poultry,
fish and wildlife. Vaccine protocols including antigen selection and
revaccination intervals should be individualized at the animal or
group level as part of a comprehensive veterinarian-supervised
preventative health care plan.”

**Shortage of Veterinarians:** Anecdotal information and
surveys in some provinces indicate a shortage of veterinarians and
veterinary technologists/technicians across Canada. The
CVMA conducted research on some labor market studies from
other professions in Canada and abroad and reviewed federal
government-produced studies on the veterinary and veterinary
technology/technician professions in Canada. The CVMA will
conduct its own labor market study and ask the Canadian
Council of Veterinary Registrars whether it is interested in
participating. Such a study would help assess the current labor
market situation and provide forecasting. Analytics can then be
used for such purposes as informing veterinary college funders
and assessment by Immigration Canada of labor market needs.

la révision des affiches sur la douleur maintenant désuètes pour
les petits et les grands animaux, plusieurs nouveaux énoncés
de position sur la douleur, des articles dans *La Revue vétérinaire
canadienne (La RVC)* et des initiatives de communication.

**Enjeux nationaux**

**Défense des intérêts :** L’ACMV a comparu devant le Comité
permanent de l’agriculture et de l’agroalimentaire de la Chambre
des communes sur la question de la perception et de la confiance
du public à l’égard du secteur agricole canadien.

**Antibiogouvernance :** L’ACMV appuie les médecins
vétérinaires dans la transition continue vers les nouvelles politiques
d’utilisation des antimicrobiens vétérinaires de Santé Canada (les
antimicrobiens importants sur le plan médical sont maintenant sur
ordonnance seulement) et les nouveaux réglementations. Citons en
exemple l’évolution continue de son site Web avec des liens vers
les collaborateurs et les intervenants, dont l’Association de nutrition
animale du Canada, l’Institut canadien de la santé animale et la
Direction des médicaments vétérinaires de Santé Canada. L’ACMV
a convoqué une réunion avec le Comité consultatif canadien sur la
réglementation des produits de santé animale afin de développer
des communications de rayonnement vétérinaire.

Les Lignes directrices de l’ACMV sur l’administration judiciaire
des antimicrobiens ont été révisées et étendues à six espèces
(y compris les petits animaux) et publiées le 30 novembre 2018.
La prochaine étape de ce projet sera de peaufiner les nouvelles
lignes directrices en ligne sur l’administration judiciaire des
antimicrobiens et d’ajouter des lignes directrices pour l’aquaculture
et les équidés. De plus, ce projet (pour lequel des fonds fédéraux
ont été proposés) inclura un projet pilote sur la surveillance de
l’utilisation des antimicrobiens au sein d’un groupe limité de
praticiens pour animaux destinés à l’alimentation; des activités
de communication afin de rehausser la sensibilisation et le
transfert des connaissances et des meilleures pratiques sur
l’antibiogouvernance auprès des médecins vétérinaires et du public;
et des ressources pour appuyer et promouvoir des solutions de
remplacement à l’utilisation des antimicrobiens.

**Vaccination des animaux :** Le Conseil a approuvé la révision
de l’énoncé de position suivant :

«L’Association canadienne des médecins vétérinaires (ACMV)
appuie l’utilisation des vaccins par les médecins vétérinaires pour
contêôler et prévenir les maladies infectieuses chez les animaux, y
compris les animaux domestiques, la volaille, les poissons et la faune.
Les protocoles de vaccination, incluant la sélection des antigènes et
les intervalles de rappel, devraient être personnalisés pour l’animal ou
au niveau du groupe dans le cadre d’un régime de soins préventifs
complet supervisé par un médecin vétérinaire.»

**Pénurie de médecins vétérinaires :** Des renseignements
anecdotiques et des sondages dans certaines provinces indiquent
une pénurie de médecins vétérinaires et de techniciens et
technologies vétérinaires au Canada. L’ACMV a réalisé de la
recherche sur certaines études sur le marché du travail d’autres
professions au Canada et à l’international et a examiné des
études produites par le gouvernement fédéral sur les professions
de médecins vétérinaires et de techniciens et technologies
vétérinaires au Canada. L’ACMV réalisera sa propre étude sur
le marché du travail et demandera au Conseil canadien des

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SCVMA Student Symposium

The 2019 Symposium of the Students of the CVMA took place at la Faculté de médecine vétérinaire de l’Université de Montréal, under the theme “One Health, One Symbiosis” and focused on the important role veterinarians play in ensuring the health of the environment, people and animals. The event attracted 258 participants. The 2020 SCVMA Symposium will be held on January 17 & 18 at the Western College of Veterinary Medicine.

CVMA Awards

CVMA Council selected the following 2019 CVMA Awards recipients:

Small Animal Practitioner Award: Dr. Kate Lupton
Merck Veterinary Award: Dr. Karin Orsel
Humane Award: Dr. Denis Will
Practice of the Year Award: Dr. Trina Bailey and the Veterinary Specialty Center of Newfoundland and Labrador
Life Membership: Dr. Jim Brackett
RVL Walker Award: Ms. Kate Rundle
President’s Award: Dr. Lloyd Keddie

The CVMA would like to congratulate all the Award winners for their distinguished accomplishments.

The Award winners will be honored at the 2019 CVMA Award Ceremony taking place in Toronto on Tuesday, July 16, 1:15 pm to 2:00 pm, during the 2019 CVMA Convention/WSAVA Congress. The Award Ceremony takes place immediately following the 2019 CVMA Annual General Meeting, which commences at 12:00 noon. Both events will take place in Room 801 A-B in the Metro Toronto Convention Centre.

2019 CVMA Convention/World Small Animal Veterinary Association Congress

The CVMA will bring the “veterinary world” to Canada by co-hosting the CVMA Convention/WSAVA in Toronto, July 16 to 19. This event offers 4 days of Continuing Education (CE), with 10 tracks each day covering a broad range of small animal sessions and CE topics such as Business Management, Dentistry, Exotics, Equine Welfare, Equine Diagnostic Imaging, and much more. The CVMA is presenting the CVMA Global Summit with the theme “The Gold Standard of Animal Welfare — Positive and Negative Impact on Animals and Veterinarians” and the CVMA Global Forum with the theme “The Implications of Telehealth and Telemedicine on Animal Welfare,” both taking place on Tuesday, July 16. The Congress is hosting pre-event labs and workshops such as the Veterinary Outreach Program taking place on Saturday, July 13. The World Congress is not one to be missed as it gives you an opportunity to network with your international peers, learn from veterinarians around the world, and showcase your country to an international audience.

Prix de l’ACMV

Le Conseil de l’ACMV a choisi les récipiendaires suivants pour les Prix 2019 de l’ACMV :

Prix du praticien des petits animaux : Dr. Kate Lupton
Prix vétérinaire Merck : Dr. Karin Orsel
Prix humanitaire : Dr. Denis Will
Prix de la pratique de l’année : Dr. Trina Bailey et le Veterinary Specialty Center of Newfoundland and Labrador
Titre de membre à vie : Dr. Jim Brackett
Prix RVL Walker : Mme Kate Rundle
Prix du président : Dr. Lloyd Keddie

L’ACMV aimerait féliciter tous les lauréats pour leurs réalisations distinguées.


Congrès 2019 de l’ACMV/World Small Animal Veterinary Association

L’ACMV invite le «monde vétérinaire» au Canada en coorganisant le congrès de l’ACMV/WSAVA à Toronto, du 16 au 19 juillet. Cet événement offrira quatre jours de formation continue avec 10 volets chaque jour qui comporteront un vaste éventail d’ateliers pour petits animaux et porteront sur d’autres sujets comme la gestion commerciale, la dentisterie, les animaux exotiques, le bien-être des équidés, l’imagerie diagnostique des équidés et plus encore. L’ACMV présentera le Sommet mondial de l’ACMV sous le thème “La norme d’excellence en matière de bien-être des animaux — Impact positif et négatif sur les animaux et les médecins vétérinaires” et le Forum mondial de l’ACMV sous le thème «Les répercussions de la télésanté et de la télé médecine sur le bien-être animal» qui se dérouleront tous deux le mardi 16 juillet. Le congrès organise des laboratoires et des ateliers avant l’événement, comme le programme «Veterinary Outreach Program» qui aura lieu le samedi 13 juillet. Le congrès mondial est à ne pas manquer car il vous donnera l’occasion de réseauter avec vos collègues internationaux, d’apprendre auprès de vétérinaires de toutes les régions du monde et de présenter votre pays à un public international.
N

L'Association canadienne des médecins vétérinaires (ACMV) a créé une nouvelle plateforme en ligne à l'intention des médecins vétérinaires du Canada afin de les aider dans la prise de décisions sur l'utilisation des antimicrobiens chez les animaux.

Les Lignes directrices de l'ACMV pour l'utilisation des antimicrobiens vétérinaires se trouvent sur le site Web de l'ACMV sous l'onglet Pratique et finances (www.veterinairesaucanada.net/AMU-UAM). Vous pouvez aussi y accéder sur la page d'accueil en cliquant sur le bouton dans le coin supérieur droit.

La plateforme porte sur six groupes d'espèces :
1. Bovins
2. Bovins laitiers
3. Volaille
4. Porcs
5. Petits ruminants
6. Animaux de compagnie (chiens, chats)

Tous les médecins vétérinaires autorisés du Canada auront droit au plein accès à l'ensemble du contenu de la plateforme d'information jusqu'au 31 décembre 2019. Après cette date, seuls les membres actifs de l'ACMV auront droit au plein accès. En tant que membre ou non-membre de l'ACMV, vous avez besoin de votre nom d'utilisateur et mot de passe pour accéder à la plateforme. Contactez l’ACMV par courriel (admin@cvma-acmv.org) ou par téléphone au (800) 567-2862 si vous ne possédez pas ces données.

Nous apprécions votre rétroaction. Veuillez acheminer vos commentaires ou vos questions à propos de la nouvelle plateforme en ligne à (AMU-UAM@cvma-acmv.org).

Durant 2017 et 2018, l'élaboration de la mise à jour des lignes directrices vétérinaires pour l'utilisation des antimicrobiens a été appuyée par des fonds provenant du Programme Agri-assurance d’Agriculture et Agroalimentaire Canada et de l'Agence canadienne d'inspection des aliments.
Experience Toronto: Discover the World
July 16–19, 2019

The WSAVA/CVMA Congress is less than 1 month away! Here’s your chance to experience a World Congress in YOUR own country.

You can register online, for full registration or daily passes, to experience the world’s top meeting place for veterinarians. Top-notch speakers from Canada, United States and overseas have been invited to speak to bring you over 50 continuing education tracks.

Join your colleagues at the CVMA Annual General Meeting and Awards Ceremony held on Tuesday, July 16 where you can observe your peers receiving awards and being recognized for their achievements in the veterinary profession. Tickets must be ordered in advance with your registration to receive your complimentary lunch ticket.

Be sure to visit the exhibit hall, which opens on Tuesday July 16 and runs for the duration of the Congress. In addition to the 80 companies waiting to engage with you, the CVMA will also have a booth where you can learn about membership services, enter your name into daily draws and of course, get your photo taken with Biscuit.

Save your seat for the Canadian Theme Night on Thursday, July 18 at the Evergreen Brickworks. This is a night you won’t want to miss. You will be greeted by local buskers, enjoy local food, local drinks and finish the night off with music and dancing. Be sure to purchase your social ticket with your Congress registration while quantities last.

For information on speakers, sessions and program scheduling, please visit the interactive scientific program online for the latest details.

(by Sarah Cunningham, Manager, Conventions)

Faites l’expérience de Toronto : Découvrez le monde
Du 16 au 19 juillet 2019

Le congrès de la WSAVA/ACMV aura lieu dans moins d’un mois! C’est l’occasion de vivre un congrès mondial dans votre PROPRE pays.

Vous pouvez vous inscrire en ligne, pour obtenir une inscription complète ou quotidienne, afin de faire l’expérience du lieu de rencontre mondial par excellence pour les vétérinaires. Nous avons invité des conférenciers de calibre supérieur provenant du Canada, des États-Unis et d’outremer qui vous présenteront plus de 50 volets de formation continue.

Joignez-vous à vos collègues lors de l’Assemblée générale annuelle et cérémonie de remise des prix de l’ACMV qui auront lieu le mardi 16 juillet où vous pourrez observer vos pairs qui recevront des prix et seront reconnus pour leurs réalisations au sein de la profession vétérinaire. Des billets doivent être commandés à l’avance avec votre inscription pour recevoir le repas gratuit.

N’oubliez pas de visiter le Salon des exposants qui ouvrira le mardi 16 juillet et sera présenté pendant la durée du congrès. En plus des 80 compagnies qui seront présentes pour vous engager, l’ACMV aura un stand où vous pourrez vous renseigner à propos des services aux membres, inscrire votre nom à des tirages quotidiens et, bien entendu, faire prendre votre photo avec Biscuit.

Réservez votre place à la soirée thématique canadienne qui aura lieu le jeudi 18 juillet à Evergreen Brickworks. C’est une soirée que vous ne voudrez pas manquer. Vous serez accueillis par des amuseurs de rue, savourerez de la gastronomie et des boissons locales et vous finirez la soirée avec de la musique et de la danse. N’oubliez pas d’acheter votre billet pour la soirée sociale avec votre inscription au congrès pendant qu’il est encore temps.

Pour obtenir les tout derniers renseignements sur les conférenciers, les ateliers et le calendrier, veuillez visiter le programme scientifique interactif.

(par Sarah Cunningham, gestionnaire, Congrès)
Optimal Nutrition for Optimal Health: Talk to Your Veterinary Team about Your Animals’ Dietary Needs

Animal Health Week 2019
October 6–12

It’s time to start planning for Animal Health Week 2019! Each year, through Animal Health Week, the veterinary community draws attention to an important health-related message. During the first week of October, veterinary teams across Canada promote a significant animal health-related message and responsible animal ownership as part of Animal Health Week celebrations. Many veterinary hospitals and clinics host open houses, hold photo contests, offer clinic tours, and organize various events for their community.

The CVMA is proud to have celebrated Animal Health Week across the country for more than 30 years. From October 6–12, 2019, CVMA will showcase the importance of nutrition. This year’s theme, Optimal Nutrition for Optimal Health: Talk to Your Veterinary Team about Your Animals’ Dietary Needs, is an opportunity to remind animal owners about the importance of seeking professional veterinary advice regarding what and how much they feed their animals based on species, age, and overall health. Eating a balanced diet is as important for our pets, livestock, and other animals as it is for us. Proper nutrition can help set the stage for our animals to live healthy lives.

A free Animal Health Week poster has been included with this month’s issue of The Canadian Veterinary Journal. A copy of the poster will also be mailed to veterinary hospitals and clinics across the country in June. Downloadable/printable order forms will be available on our website for those who do not wish to use the online ordering system. As Animal Health Week nears, visit the Animal Health Week section under the Practice & Economics tab of the CVMA website (www.canadianveterinarians.net) to find tips and tools to help plan your celebrations. Choose from a variety of promotional materials to decorate your waiting room and items to distribute as prizes.

Nutrition optimale = santé optimale : Consultez votre équipe vétérinaire pour vous renseigner sur les besoins alimentaires de votre animal

Semaine de la vie animale 2019
Du 6 au 12 octobre

Il est temps de commencer à planifier la Semaine de la vie animale 2019! La Semaine de la vie animale (SVA) est une campagne nationale de sensibilisation du public qui est organisée par l’Association canadienne des médecins vétérinaires (ACMV) et mise en œuvre par les vétérinaires à l’échelle du Canada. Chaque année, lors de la Semaine de la vie animale, la collectivité vétérinaire attire l’attention sur un message important pour la santé. Durant la première semaine d’octobre, les équipes du Canada feront la promotion d’un message important relativement à la santé animale et à la possession responsable des animaux dans le cadre des célébrations de la Semaine de la vie animale. Beaucoup de cliniques et d’établissements vétérinaires organiseront des journées portes ouvertes, tiendront des concours de photos, offriront des visites de la clinique ainsi que diverses activités pour leur collectivité.

L’ACMV est fière d’avoir célébré la Semaine de la vie animale au Canada depuis plus de 30 ans. Du 6 au 12 octobre 2019, l’ACMV soulignera l’importance de la nutrition. Le thème de cette année, Une nutrition optimale = santé optimale : Consultez votre équipe vétérinaire pour vous renseigner sur les besoins alimentaires de votre animal, représente l’occasion de rappeler aux propriétaires d’animaux à propos de l’importance de solliciter des conseils vétérinaires professionnels concernant la quantité et le type d’aliments à donner à leurs animaux en fonction de l’espèce, de l’âge et de l’état de santé général. Une diète équilibrée est tout aussi importante pour les animaux de compagnie, le bétail et les autres animaux que pour nous. Une nutrition adéquate peut aider à créer les conditions requises pour permettre à nos animaux de vivre une vie en santé.

Une affiche gratuite a été incluse dans le présent numéro de La Revue vétérinaire canadienne. En juin, un exemplaire de l’affiche sera aussi envoyé par la poste aux cliniques et aux établissements vétérinaires du pays. Des formulaires de commande téléchargeables et imprimables seront disponibles sur notre site Web pour les personnes qui ne désirent pas utiliser le système de commande en ligne. À l’approche de la Semaine de la vie animale, visitez la section Semaine de la vie animale sous l’onglet Pratique et finances du site Web de l’ACMV (www.veterinairesaucanada.net) pour découvrir des conseils et des outils qui vous aideront à planifier vos célébrations. Choisissez parmi un éventail d’articles promotionnels afin de décorer votre salle d’attente et de distribuer des prix.

Commandez votre marchandise de la Semaine de la vie animale en ligne

Pour plus de commodité, vous pouvez commander votre marchandise de la Semaine de la vie animale en ligne sur le site Web de l’ACMV à compter de la première semaine de juin jusqu’au 2 août 2019. Profitez aussi de la date de commande hâtive du
Order your Animal Health Week merchandise online
You can conveniently order your Animal Health Week merchandise online through CVMA’s website from the first week of June until August 2, 2019. Take advantage of the Early Bird deadline, July 19, 2019, for a chance win a $100 Subway gift card! Those who order through the online system will also receive a chance to win additional prizes.

Sponsors
Generous support of the 2019 Animal Health Week campaign is provided by Principal Sponsor, Royal Canin, and Program Sponsors, iFinance Canada (Petcard), and The Personal.

This month we highlight our Principal Sponsor, Royal Canin:
Royal Canin believes pets make our world a better place and this drives them to make A Better World for Pets™. Pets do not have a voice to speak for themselves, but each of us can speak on their behalf. Royal Canin leverages science and observation to help each cat and dog live longer and in better health through optimal nutrition. Royal Canin believes in continuous innovation, pushing the limits of health nutrition through precision, individualization, diagnostic tools, and supporting services, keeping cats and dogs at the center, and believing that nutrition can transform their lives.

They research the complex physiological needs of cats and dogs and develop detailed nutritional solutions that are appropriate to their size, age, lifestyle, breed, and medical pathology. The company’s network of research facilities, including the Waltham Centre for Pet Nutrition, and pet professional partners worldwide provide the necessary knowledge for their nutritionists and formulators to meet the specific needs of each cat and dog. Their dedication does not end there. Around the world they have veterinarians, boarded nutritionists, internists, and registered veterinary technicians available to answer your questions related to nutrition and products. These consultations feed into the knowledge to identify opportunities for improvements and innovations. Royal Canin provides over 100 dry and wet canine and over 90 dry and wet feline formulas that make a positive and lasting difference in a pet’s ability to live in optimal health.

The majority of dry formulas for the Canadian market are produced at the facility in Guelph, Ontario. This facility is part of a network of Royal Canin-owned plants in North America. Royal Canin facilities adhere to strict quality and food safety controls to help ensure nutritional precision and performance. Each Royal Canin Veterinary Exclusive formula is available through your local distributor.

For additional information about Animal Health Week, follow CVMA on Twitter (in English @CanVetMedAssoc and in French @Assoccanmedvet) and Instagram (@CVMA.ACMV), and like us on Facebook (facebook.com/CanadianVeterinaryMedicalAssociation). Use #AnimalHealthWeek for all of your Animal Health Week social media promotions.

19 juillet 2019 pour courir la chance de gagner une carte-cadeau de 100 $ chez Subway! Les personnes qui commandent sur le système en ligne pourront aussi gagner des prix additionnels.

Commanditaires
Un généreux soutien de la campagne de la Semaine de la vie animale 2019 est fourni par le commanditaire principal, Royal Canin, et les commanditaires de programme, iFinance Canada (Petcard) et La Personnelle.

Ce mois-ci, nous présentons notre commanditaire principal, Royal Canin :
Royal Canin croit que, grâce aux animaux de compagnie, nous vivons dans un monde meilleur et cela motive l’entreprise à créer Un monde meilleur pour les animaux Royal CaninMD. Les animaux n’ont pas de voix pour parler en leur propre faveur, mais nous pouvons tous parler en leur nom. Royal Canin met à contribution la science et l’observation pour aider chaque chat et chien à vivre plus longtemps et en meilleure santé grâce à la nutrition optimale. Royal Canin croit en l’innovation continue, en repoussant les limites de la nutrition de santé par la précision, la personnalisation, les outils diagnostiques et les services de soutien, afin de garder les chats et les chiens au centre de nos priorités, car elle estime que la nutrition peut transformer leur vie.

Royal Canin effectue de la recherche sur les besoins physiologiques complexes des chats et des chiens et elle met au point des solutions de nutrition qui sont appropriées à leur taille, à leur âge, à leur style de vie, à leur race et à leur pathologie médicale. Le réseau mondial d’installations de recherche de l’entreprise, y compris le Waltham Centre for Pet Nutrition et des partenaires professionnels pour les animaux de compagnie, fournit les connaissances nécessaires aux nutritionnistes et les formulateurs pour qu’ils puissent répondre aux besoins de chaque chat et chien. Leur dévouement ne s’arrête pas ici. Partout dans le monde, ils comptent sur des vétérinaires, des nutritionnistes agréés, des internistes et des techniciens vétérinaires agréés qui sont disponibles pour répondre à vos questions sur la nutrition et les produits. Ces questions alimentent ensuite les connaissances afin d’identifier des occasions d’amélioration et d’innovation. Royal Canin fournit plus de 100 formules sèches et humides pour chiens et plus de 90 formules sèches et humides pour chats afin d’exercer une influence positive et de longue haleine sur la capacité d’un animal de compagnie à vivre en santé optimale.

La majorité des formules sèches pour le marché canadien sont produites à l’installation de Guelph, en Ontario. Cette installation fait partie du réseau d’usines appartenant à Royal Canin en Amérique du Nord. Les installations de Royal Canin respectent des contrôles stricts en matière de qualité et de salubrité alimentaire afin d’assurer une précision et une performance nutritionnelles. Tous les produits Royal Canin Formule vétérinaire sont disponibles par l’entremise de votre distributeur local.

Pour en savoir davantage à propos de la Semaine de la vie animale, suivez l’ACMV sur Twitter (en français @Assoccanmedvet et en anglais @CanVetMedAssoc) et sur Instagram (@CVMAACMV) et ainez-nous sur Facebook (facebook.com/CanadianVeterinaryMedicalAssociation). Utilisez #Semanedelavieanimale pour toutes vos promotions de la Semaine de la vie animale dans les médias sociaux.
Find Out How the CVMA Supports Your Business and Saves You Money

The CVMA's first 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 and 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. Here are benefits and services available to you FOR FREE:

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 new 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

HRdownloadsTM 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

Découvrez comment l’ACMV appuie votre entreprise et vous permet de réaliser des économies

Les grandes priorités de l’ACMV sont le leadership, l’avancement des intérêts des médecins vétérinaires canadiens et l’influence du gouvernement et des organismes politiques à l’égard des enjeux qui vous affectent ainsi que la santé et le bien-être animaux. À titre de membres de l’ACMV, vous appuyez ces priorités et votre adhésion nous permet aussi d’effectuer de la recherche et de vous offrir des façons dont vous pouvez appuyer votre entreprise et réaliser des économies.

Tous les membres de l’ACMV peuvent profiter d’un vaste éventail de services, de privilèges et de rabais. Voici des avantages et des services qui vous sont offerts GRATUITEMENT:

1. Une période d’essai GRATUITE de 30 jours de Sofie, un outil de recherche qui a été créé par des vétérinaires pour un accès plus rapide et plus facile à des renseignements médicaux vétérinaires actuels et crédibles. De plus, le nouveau partenariat de l’ACMV avec LifeLearn Animal Health permet aux membres de l’ACMV de recevoir un rabais de 10 % sur Sofie et trois autres produits LifeLearn : utilisez les sites Web personnalisés WebDVM afin d’améliorer l’organisation des moteurs de recherche, utilisez ALLYDVM pour effectuer un suivi, prendre des rendez-vous et envoyer des rappels automatiques pour les rendez-vous et accédez à ClientEd pour une bibliothèque en ligne d’articles sur la santé animale.

2. Une trousse GRATUITE de documents sur les ressources humaines par l’entremise du partenaire de l’ACMV HRdownloads! Économisez du temps et obtenez du soutien de la part d’experts en RH qui connaissent les besoins de l’industrie vétérinaire canadienne. Votre trousse gratuite comprend les documents suivants:
   • Description de travail d’un technicien vétérinaire
   • Politique sur les accréditations professionnelles
   • Politique de conformité au Système d’information sur les matières dangereuses (SIMDUT) (SGH) 2015
   • Lettre d’avertissement
   • Formulaire d’évaluation du rendement des employés

HRdownloadsTM également offre aux membres de l’ACMV un rabais de 10% sur d’autres documents qui vous économiseront temps et de l’aide à des enjeux du gouvernement et des organismes politiques à l’égard des enjeux qui vous affectent ainsi que la santé et le bien-être animaux.
and human resources courses, a booklet containing simple checklists you should be following for effective practice management, cost of living comparisons across Canada, as well as guides, tips, and articles all aimed to help your practice succeed. Additional resources will be posted as we determine their relevance.

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, your national issues and animal welfare position statements and awards and honors information recognizing your colleagues’ achievements. You can also use this guide to contact your 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.

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, please visit the CVMA website (www.canadianveterinarians.net/membership/benefits-services) and if you have any questions or require more information or application forms, contact the CVMA (admin@cvma-acmv.org).

and argent, du soutien en direct sur les RH offert pas des conseillers de RH chevronnés, des sondages en ligne, des solutions de formation pour des RH plus efficaces et plus encore!

3. **Une trousse d’outils GRATUITE pour la carrière et les affaires.** Cette trousse d’outils en ligne de l’ACMV porte sur la gestion des finances personnelles, la gestion d’une entreprise vétérinaire et la gestion de la clientèle et elle comprend des liens vers des cours GRATUITS sur les affaires, le marketing ainsi que les communications et les ressources humaines, un livret contenant des listes de contrôle simples que vous devriez suivre pour une gestion efficace d’une clinique, la comparaison du coût de la vie au Canada ainsi que des guides, des conseils et des articles qui visent à assurer le succès de votre clinique. Des ressources additionnelles seront affichées lorsque nous déterminerons leur pertinence.


5. **Des conseils juridiques GRATUITS** par l’entremise du Droit vétérinaireMD, la rubrique en ligne de conseils juridiques de l’ACMV.

6. **Un guide de ressources GRATUIT de l’ACMV** qui sert d’outil de référence utile pour votre association nationale, la collectivité vétérinaire canadienne, les groupes de spécialistes et les organisations vétérinaires ainsi que les fournisseurs de l’industrie. Dans ce guide, vous trouverez aussi une liste complète des avantages et privilèges des membres de l’ACMV, vos énoncés de position sur les enjeux nationaux et le bien-être animal ainsi que des renseignements sur les prix et distinctions qui reconnaissent les réalisations de vos collègues. Vous pouvez aussi vous servir de ce guide pour contacter vos pairs, vos collègues et vos confrères et consœurs. Le Guide des ressources de l’ACMV contient une liste des bureaux, des comités et des représentants de l’ACMV, des associations de médecins vétérinaires nationales et internationales, des écoles de médecine vétérinaire et des groupes nationaux pour les espèces spécifiques.

Vous trouverez ci-dessous une liste de certains **rabais** dont peuvent aussi se prévaloir les membres de l’ACMV :

1. **Moneris et Ma Vitrine Vétérinaire** offrent des tarifs préférentiels aux membres de l’ACMV.

2. **Petcard** offre en exclusivité des avantages spéciaux, des incitatifs et des récompenses aux membres de l’ACMV.

3. **Économisez jusqu’à 50 %**, avec des tarifs qui sont en moyenne de 5 % à 20 % inférieurs à ceux des autres services de réservation d’hôtels en ligne, grâce au **Programme des rabais hôteliers de l’ACMV**.

4. **Économisez jusqu’à 44 %** sur les tarifs réguliers d’un abonnement individuel grâce au **Programme de rabais corporatifs de l’ACMV — GoodLife Mise en forme**.

Pour une liste complète des avantages et services aux membres de l’ACMV, veuillez visiter le site Web de l’ACMV (www.veterinairesaucanada.net/membership/benefits-services). Si vous avez des questions ou si vous avez besoin de plus amples renseignements ou de formulaires de demande, veuillez contacter l’ACMV (admin@cvma-acmv.org).
Gastric dilatation and volvulus (GDV) is an acute and life-threatening disorder characterized by a progressively gas-distended stomach, which rotates along its longitudinal axis, subsequently leading to cardiovascular compromise. Despite immediate medical treatment and surgical intervention, mortality rates up to 33% have been reported (1–5). Gastric dilatation and volvulus syndrome occurs frequently in many large and giant breed dogs with the following breeds most commonly affected: Akita, bloodhound, Great Dane, Irish setter, Irish wolfhound, and standard poodle (2–4). Currently, GDV has only been described in adult dogs, with increasing age reported as being a risk factor (1–4,6,7).

This case report describes the clinical findings in a 5-month-old Bernese mountain dog, which was presented with GDV. To the authors’ knowledge, GDV has not been previously reported in a puppy.

Case description
A 5-month-old, 29-kg, intact male Bernese mountain dog was presented with a 2-hour history of unproductive vomitus and abdominal dilatation (Figure 1). The patient did not have any history of disease and had been regularly vaccinated. On initial physical examination, the dog was bright, alert, and responsive. Body temperature was within normal limits. The dog showed tachypnea of 30 breaths/min, tachycardia of 120 beats/min, and congested mucous membranes with a capillary refill time 2 s. Mild ptyalism was noted along with abdominal dilatation and tympany bilaterally behind the 13th rib. The remainder of the physical examination was unremarkable. A packed cell volume measurement revealed hemoconcentration [hematocrit 0.58 L/L; reference interval (RI): 0.37 to 0.55 L/L]. The serum chemistry profile revealed uremia (9.64 mmol/L; RI: 2.5 to 9.0 mmol/L), hyperphosphatemia (2.83 mmol/L; RI: 0.94 to 2.13 mmol/l), hypercalcemia (3.04 mmol/L; RI: 2.15 to 2.94 mmol/L), and elevated alanine aminotransferase (ALT; 653 U/L; RI: 10 to 118 U/L) and alkaline phosphatase (ALP; 223 U/L; RI: 20 to 150 U/L). A right-lateral abdominal radiograph revealed severe gastric dilatation and a typical “reverse C sign” consistent with GDV (Figure 2).

The dog was given a bolus of crystalloids (Chlorure de sodium 0.9%; B. Braun, Bouloigne Billancourt, France), 20 mL/kg body weight (BW), IV, potentiated amoxicillin-clavulanic acid (Augmentin; GlaxoSmithKline, Marly-le-Roi, France).
20 mg/kg BW, IV, q8h, morphine (Morphine; Lavoisier, Paris, France), 0.2 mg/kg BW, SQ, q4h, and ranitidine (Azantac; GlaxoSmithKline), 1 mg/kg, IV, q12h. The patient was premedicated with diazepam (Valium; Roche, Boulogne-Billancourt, France), 0.2 mg/kg BW, IV. Anesthesia was induced with propofol IV (PropoVet; Zoetis, Malakoff, France) as needed and maintained with an isoflurane/oxygen mixture. Intravenous crystalloids were continued at a rate of 10 mL/kg per hour.

Surgery was performed by a Board-certified surgeon (JGG). A standard ventral midline laparotomy was conducted and confirmed the radiographic findings of GDV with a gastric rotation of 270° (Figure 3A). The right and left short gastric vessels were torn causing a moderate hemoabdomen (Figure 3B).

Blood (400 mL) was aspirated from the abdominal cavity. Derotation of the stomach was conducted followed by stomach decompression using an orogastric tube. After correction of the gastric malposition, the stomach and spleen were both evaluated. The gastric wall did not show any signs of devitalized tissues and there was no evidence of thrombosis or necrosis of the spleen. An incisional right-sided gastropexy was performed with 2 simple continuous patterns of 0 polyglyconate suture material (Monosyn; B. Braun, Tuttingen, Germany). The abdominal cavity was lavaged with warm, isotonic saline (Chlorure de sodium 0.9%; B. Braun), and the abdominal incision was closed routinely. No intra-operative complications occurred. The electrocardiogram remained normal throughout the surgery and the immediate post-operative period.

The dog made an uneventful recovery. Morphine was administered after surgery for 24 h (Morphine; Lavoisier), 0.2 mg/kg BW, SQ, q4h. Potentiated amoxicillin-clavulanic acid (Synulox; Zoetis), 20 mg/kg BW, PO, was administered twice daily. Blood pressure was recorded every 6 h and hematocrit and total protein were recorded 24 h after surgery. The hematocrit was 0.33 L/L (RI: 0.37 to 0.55 L/L) and total protein was 42 g/L (RI: 55 to 75 g/L).

The dog was discharged 3 d after surgery. Medication prescribed included potentiated amoxicillin-clavulanic acid (Synulox; Zoetis), 15 mg/kg BW, PO, q12h, for 5 d. Activity restriction was advised for 3 wk along with fractionated meals (3 times daily) of a hyper-digestible diet.

On recheck examination 2 wk after surgery by the referring veterinarian, the dog was bright, alert, and responsive with vital signs within normal limits. The skin incision was intact and appropriate, and skin sutures were removed. The owner reported normal appetite with no vomitus or regurgitation, normal water intake, and normal feces. At the last telephone follow-up 8 mo after surgery, the dog was in excellent physical condition with no recurrence of clinical signs or clinical episodes of gastric dilatation.

**Discussion**

In the case presented here, GDV was diagnosed in a 5-month-old Bernese mountain dog. To our knowledge, this is the first report of GDV in a puppy.

The etiology of GDV remains unclear and is influenced by several risk factors (1), with the following identified in retrospective epidemiological studies: being a large or giant purebred dog (1), increasing age (1,6), increasing thoracic depth-to-width ratio (1,3,8), having a relative with a history of GDV (3), and eating a diet containing small particles of food (6). Glickman et al (9) found in a study involving 202 dogs, that overweight dogs or dogs of thin body condition, eating 1 meal daily, eating rapidly, having a fearful temperament, or experiencing...
a stressful event in the 8 h before the GDV episode, were at increased risk. Male gender was also found to be a risk factor in one study (9), whereas in another sexually intact females had the highest risk for GDV (10). Inflammatory bowel disease has also been implicated as a risk factor for GDV (11). Sartor et al (12) found increased odds of GDV in dogs with a history of previous splenectomy. Our dog did not have a history of chronic disease and had a normal body condition score at the time of surgery. His conformation was appropriate to age and breed standards.

Breeds at higher risk for GDV include the Great Dane, German shepherd, Irish setter, Weimaraner, Saint Bernard, and standard poodle (1–5). In studies from the United Kingdom and the United States, the Bernese mountain dog has not been found to be a high-risk breed for GDV. A recent study by Uhrikova et al (13) analyzed risk factors for GDV in central Europe and found the Bernese mountain dog to be the second most represented breed after the German shepherd (13). Therefore, the prevalence of GDV across breeds is likely to vary across countries according to frequencies of various breeds. In the treatment of clinical cases at their practice, the authors have also noticed that GDV was frequently observed in Bernese mountain dogs.

Gastric dilatation and volvulus has only been reported in adult dogs. Previous retrospective epidemiological studies identified increasing age as a risk factor for GDV (4,6,14) and age as the most important risk factor for GDV in Great Danes (7). In a retrospective study involving 151 dogs with GDV, median age at presentation was 9 y (range: 2 to 17 y) (12). In another study of 64 dogs, age ranged from 1.3 to 14.6 y (median: 8.2 y) (15). Schellenberg et al (3) reported that the odds ratio for development of GDV increased by 33% for each year of life.

In our case, an incisional gastropexy was performed. Various gastropexy techniques have been described with differing success rates and included: incisional, belt-loop, circumcostal, endoscopically assisted, laparoscopic gastropexy, gastrocolopexy, and incorporating gastropexy in which the gastric wall is included in the linea alba closure. Biomechanical testing for commonly performed open gastropexy techniques yielded similar results (16–20). However, cautious interpretation of quantitative biomechanical testing results is necessary as the absolute strength of gastropexy for prevention of GDV is unknown. It is generally accepted that the incisional gastropexy is a strong, relatively quick, and easy technique to perform to prevent GDV.

The reported lifetime likelihood of developing GDV is 24% in large-breed show dogs and 21.6% in giant-breed show dogs. Lifetime risk of developing GDV syndrome is as high as 42% in Great Danes (4). Because GDV is associated with mortality rates up to 33% (1,2,9) and can be observed in puppies, it seems appropriate to consider a prophylactic gastropexy in juvenile dogs with a known breed predisposition for GDV (21).

Post-operative complications after prophylactic gastropexy have rarely been reported and include self-limiting gastrointestinal disease characterized by vomiting, regurgitation, diarrhea, and inappetence (22–25). Less frequently documented post-operative complications following elective gastropexy include suture site reaction or infection, seroma formation, aspiration pneumonia, and ventricular arrhythmias (21–24). In 1 case report, chronic intermittent vomiting was reported in a 20-month-old Great Dane after routine castration and prophylactic gastropexy performed via celiotomy at 6 mo of age. In that case, malpositioning of the pyloric antrum resulting in partial gastric outflow tract obstruction was suspected (26). It is possible that the dog’s dramatic growth may have exacerbated the abnormal positioning of the gastric axis. To the authors’ knowledge, no specific adverse effects have been reported in young dogs with correctly performed gastropexies (22,26).

Gastropexy can often be performed concurrently with sterilization in female dogs to avoid additional anesthetic episodes (22,27,28). Routine sterilization may be performed in dogs as early as 4 to 6 mo of age. However, no guidelines have been published with regard to minimum age or size requirements for performing prophylactic gastropexies in growing dogs.

References


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Clinical hypocalcemia following surgical resection of apocrine gland anal sac adenocarcinomas in 3 dogs
Jaime A. Olsen, Julia P. Sumner

Abstract — Three canine patients were presented with marked hypercalcemia secondary to an apocrine gland anal sac adenocarcinoma (AGASCA). Two of the patients underwent treatment for hypercalcemia before surgical resection of their tumors, including diuresis and the administration of bisphosphonates. All dogs developed clinically symptomatic hypocalcemia 2 to 4 days following surgery. Clinical signs included facial rubbing, muscle fasciculations, lameness, and collapse. The dogs each required calcium supplementation and close monitoring of serum ionized calcium, as inpatients and continuing after discharge. Hypocalcemia and associated clinical signs resolved with treatment in all cases.

Résumé — Hypocalcémie clinique après la résection chirurgicale d’adénocarcinomes du sac de glandes anales apocrines chez trois chiens. Trois patients canins ont été présentés avec une hypercalcémie marquée secondaire à un adénocarcinome du sac des glandes anales apocrines (ASGAA). Deux des patients ont subi un traitement pour l’hypercalcémie avant la résection chirurgicale de leurs tumeurs, y compris la diurèse et l’administration de bisphosphonates. Tous les chiens ont développé une hypocalcémie cliniquement symptomatique de 2 à 4 jours après la chirurgie. Les signes cliniques incluaient le frottement de la face, des fasciculations des muscles, la boiterie et le collapsus. Les chiens ont tous exigé de la supplémentation au calcium et une étroite surveillance du calcium ionisé sérique, comme patients à l’interne et après le congé. L’hypocalcémie et les signes cliniques connexes se sont résorbés avec le traitement dans tous les cas.

Humoral hypercalcemia of malignancy (HHM) is a common cause of hypercalcemia in dogs. The pathophysiology behind HHM is related to tumor-cell production of parathyroid hormone-related peptide (PTHrP), a promoter of osteoclastic activity, and osteolysis secondary to bone metastasis (1,2). Tumor types known to commonly cause HHM include lymphosarcoma, apocrine gland anal sac carcinoma (AGASCA), and squamous cell carcinoma (3). Humoral hypercalcemia of malignancy has been reported in 27% to 53% of canine patients with AGASCA (1,2). The mainstay of treatment for AGASCA involves surgical resection of the primary tumor, with or without extirpation of nodal metastases. Adjuvant radiation and chemotherapy is elected in some cases (2,4–7).

Hypocalcemia following surgical resection of AGASCA in a previously hypercalcemic patient is rare. To the authors’ knowledge, there has only been 1 other reported case in the veterinary literature (8). The presumed mechanism of calcium dysregulation in these patients is secondary hypoparathyroidism. Parathyroid hormone-related peptide production by the tumor leads to high circulating calcium levels and hence, down regulation of PTH production by the parathyroid glands. Removal of the tumor can therefore lead to hypocalcemia due to a PTH deficiency in these patients. Hypocalcemia leads to neuromuscular hyperexcitability. Clinical signs are varied and can include seizures, muscle tremors and fasciculations, stiff gait, jaw “champing,” panting, facial rubbing, biting at paws, behavioral changes, vomiting, diarrhea, inappetence, and lethargy (9). The aim of this case report is to raise awareness of the potential for clinical hypocalcemia following resection of a PTHrP producing AGASCA, which is a rare but potentially life-threatening complication.

Case descriptions

Case 1
A 9-year-old neutered male border collie cross dog was referred for workup of a palpable caudal abdominal mass. The dog had a 6-week history of intermittent inappetence and vomiting. The
owners also noted shaking hindlimbs at rest and polydipsia. Physical examination demonstrated a palpable dorso-caudal abdominal mass but was otherwise unremarkable. The anal sacs had no palpable abnormalities following evacuation.

Abdominal ultrasound was performed, and the mass was identified as severe bilateral medial iliac and hypogastric lymph node enlargement, measuring 58 × 27 mm on the left and 24 × 34 mm on the right (Figure 1). Fine-needle aspirate (FNA) of the lymph nodes was consistent with carcinoma. Complete staging was performed, consisting of complete blood (cell) count (CBC), biochemistry, and a computed tomography (CT) scan of the thorax, abdomen, and neck (pre- and post-contrast). Blood analysis demonstrated increased total calcium at 3.83 mmol/L [reference range (RR): 1.98 to 3.00 mmol/L]. The CT scan demonstrated severe enlargement of the medial iliac and hypogastric lymph nodes, causing compression of the caudal vena cava and iliac veins. Both anal sacs showed hypoechoic fluid content and no asymmetry in size. No definitive primary anal sac lesion was found on CT and there were no palpable abnormalities of either sac. Incidental findings included small hepatic nodules. Serum ionized calcium was markedly elevated at 2.41 mmol/L (RR: 1.00 to 1.40 mmol/L). Other serum chemistry and a CBC were within normal limits.

The dog was administered pamidronate (Pamisol; Hospira, Victoria, Australia) 1.2 mg/kg body weight (BW), IV, and fluid diuresis with 0.9% sodium chloride for management of the hypercalcemia. Within 24 h the ionized serum calcium was reduced to 2.12 mmol/L. Surgical resection of the metastatic lesions in the medial iliac and hypogastric lymph nodes was performed without complications 48 h after administration of pamidronate (Figure 2). The surgeon opted to continue monitoring the anal sacs for palpable lesions and proceed with surgical resection if indicated in the future. The ionized serum calcium was reduced to 1.41 mmol/L 24 h following surgery and was 1.40 mmol/L 48 h after surgery. There were no complications in the immediate peri-operative period. Histopathology of the removed lymph nodes was consistent with metastatic anal sac adenocarcinoma.

The patient was presented 4 d after surgery due to apparent discomfort and a waxing-waning lameness. On re-examination he was distinctly painful on palpation of the caudal lumbar dorsal spinous processes with no apparent neurological deficits. He also had muscle fasciculations and intermittent pain responses on palpation of all limbs. The dog was also exhibiting episodes of recumbency with vocalization and hyperesthesia. Ionized serum calcium at this time was low at 0.69 mmol/L.

The patient was treated with methadone (Methone; Ceva Animal Health, New South Wales, Australia), 0.4 mg/kg BW, IM, q12h, tramadol (Tramal; Grunenthal, Germany), 2.5 mg/kg BW, PO, q8h, and gabapentin (Neurontin; Pfizer, New York, New York, USA), 10 mg/kg BW, PO, q12h, for analgesia, and intravenous fluid therapy with Hartmann’s solution (Compound Sodium Lactate; Baxter, New South Wales, Australia) before workup. Following the diagnosis of hypocalcemia, the patient was administered an intravenous calcium gluconate (Phebra, New South Wales, Australia) constant rate infusion (CRI), 10 mg/kg BW per hour for 4 d until normocalcemia was achieved, based

**Figure 1.** Preoperative CT image (post contrast) showing enlarged sublumbar and hypogastric lymph nodes within the trifurcation of the aorta (red arrows) in Case 1: sagittal view (A), dorsal view (B), and transverse view (C).
on ionized serum calcium. Concurrently, oral calcitriol (Amneal Pharmaceuticals, Victoria, Australia), 0.01 mg/kg BW, q8h, and oral calcium carbonate (Caltrate; Pfizer), 60 mg/kg BW, q8h, were administered, and were continued following discharge. Additionally, the patient received oral diazepam (APO-Diazepam; Apotex, New South Wales, Australia), 0.1 mg/kg BW, q8h, for muscle relaxation, a fentanyl CRI (Fentanyl GH; Generic Health, Victoria, Australia), 4 μg/kg BW per hour and subsequent placement of a fentanyl patch (Durogesic; Janssen, New South Wales, Australia) 3.75 μg/kg BW per hour for ongoing analgesia.

Ionized serum calcium was closely monitored every 48 h for 2 wk following discharge. When mild hypercalcemia occurred, with ionized serum calcium of 1.54 mmol/L (2 wk following initial hypocalcemia diagnosis), oral calcitriol and calcium gluconate dosages were weaned off gradually over a period of 10 wk. The dog made a full recovery and was normocalcemic following cessation of supplementation over a follow-up time of 22 wk, with ionized calcium ranging from 1.25 to 1.37 mmol/L. The dog's anal sacs remained palpably normal over this time.

Six months after surgery the dog had a repeat abdominal ultrasound and CBC, and serum biochemistry. There were no hematological abnormalities, but recurrence of hypercalcemia was evident, with a total calcium of 3.1 mmol/L (RR: 2.2 to 2.8 mmol/L) and an ionized serum calcium of 1.46 mmol/L. Ultrasonography demonstrated a large (52 × 39 mm) ovoid lesion in the region of the hepatic lymph nodes in the mid-cranial abdomen (suspect lymph node) and another smaller lesion, similar in appearance, arising from the periphery of the right medial liver lobe. No abnormalities were seen at the site of medial iliac lymph node resection or in any other regions of the abdomen. Fine-needle aspirates from the larger mass were obtained for cytology using ultrasound guidance. Cytology was consistent with a small cell adenocarcinoma. The owner also reported some mild deterioration in the patient's exercise tolerance and appetite, increased lethargy, and frequent diarrhea. The owner declined further surgery and opted for palliative care with pamidronate 1.5 mg/kg BW to manage the dog's hypercalcemia. Within 2 d of pamidronate administration the patient was clinically doing well with improved energy levels and appetite.

At 8 to 9.5 mo after surgery, the patient remained persistently hypercalcemic (2.02 to 2.41 mmol/L) which was managed with 2 further pamidronate infusions at 1.5 to 2.25 mg/kg BW. At 10.5 mo after surgery, despite persistent hypercalcemia, further pamidronate infusions were declined. The patient was euthanized 11 mo after surgery due to lethargy and declining quality of life.

**Case 2**

A 10-year-old spayed female Labrador retriever dog was presented for a presumptive AGASCA and refractory hypercalcemia. Five days before presentation, the dog was evaluated by the referring veterinarian for excessive twitching in her sleep. A right anal sac mass was palpated and cytology revealed a carcinoma. A CBC was unremarkable, but a chemistry panel revealed a total calcium of 5 mmol/L (RR: 2.3 to 2.9 mmol/L). Calcium diuresis with intravenous 0.9% sodium chloride was initiated. The total calcium remained elevated 48 h following initiation of fluid therapy so pamidronate (Pamidronate Disodium Injection; Pfizer Medical, Bridgewater, New Jersey, USA), 1.6 mg/kg BW, IV, was given. The dog was then referred for refractory hypercalcemia 48 h after initial presentation.

On presentation the dog’s vital parameters were within normal limits. On physical examination a firm nodular right anal sac mass was palpated along with an abdominal mass in the caudal abdomen. The ionized serum calcium was 2.15 mmol/L.
were unremarkable. Abdominal ultrasound revealed urinary of the mass was consistent with an AGASCA. Chest radiographs elevated at 1.82 mmol/L (RR: 1.18 to 1.37 mmol/L). Cytology (RR: 0.9 to 1.7 mmol/L). Ionized calcium was significantly elevated at 2.3 mmol/L (0.9 NaCl + 20 mEq KCl/L). Forty-eight hours after surgery the dog was noted to have muscle fasciculations and was exhibiting face rubbing. An ionized calcium level revealed hypocalcemia (0.82 mmol/L). This was treated with a 2 mg/kg BW, IV injection of calcium gluconate followed by a CRI at 1 mg/kg BW per hour. Oral calcium carbonate (25 mg/kg BW, PO, q12h) and calcitriol (0.025 μg/kg BW, PO, q 24h) supplementation was initiated. The dog was discharged 8 d after surgery and slowly weaned off calcium supplementation over the following months. He was euthanized 4 y later secondary to intractable seizures, the cause of which was not investigated.

**Discussion**

Humoral hypercalcemia of malignancy is a common sequela of AGASCA, with hypercalcemia at presentation historically associated with reduced survival (1,2). Return to normocalcemia is generally seen following successful surgical tumor excision, and tumor recurrence or progression is generally associated with recurrence of hypercalcemia (10). Normal homeostatic mechanisms tightly regulate calcium levels. In healthy animals parathyroid hormone (PTH) acts to regulate extracellular calcium levels through its influence on bone resorption, renal reabsorption of calcium and phosphorus and formation of the active metabolite of vitamin D, calcitriol. A negative feedback loop exists whereby increased calcium levels downregulate the production of PTH and lower calcium levels increase PTH secretion (9).

Subsequent to removal of a PTHrP secreting neoplasm, ionized serum calcium levels drop. In most cases, a return to normocalcemia is considered a marker of successful treatment of AGASCA, indicating the body’s return to a state of homeostasis (10). However, in the cases reported here, despite lowered ionized calcium levels, the parathyroid glands appeared unable to produce sufficient endogenous PTH to maintain appropriate serum calcium levels. Saba et al (8) hypothesized that chronic suppression of the parathyroid glands from high circulating calcium levels in HHM subsequently led to glandular atrophy. This was based on inappropriately low PTH levels in combination with hypocalcemia, following removal of a PTHrP secreting anal sac adenocarcinoma. Similar rebound hypocalcemia is reported following induction of chemotherapy in patients with HHM related to lymphosarcoma (11,12). In order to accurately assess the pathophysiology of the hypercalcemic episodes in the cases described in this paper, measurement of PTH and PTHrP during treatment would be ideal.

In 2 cases described herein, pamidronate was administered before surgery. This may have further contributed to dysregulation of calcium homeostasis in these patients. Pamidronate primarily acts to inhibit calcium resorption from bone, and has been demonstrated to have a median duration of effect of 8.5 wk in canine patients (13). This indicates that these patients were likely to be under the effects of pamidronate at the time they
developed clinical signs of hypocalcemia. There is a possibility that the reduction in resorption of calcium from the bones contributed to the patients’ episodes of severe hypocalcemia. The other single reported case of rebound hypocalcemia (8) did not receive pamidronate as treatment. Pamidronate should, however, be used with caution for pre-operative management of these patients, and serial ionized serum calcium measurements should be employed after surgery to monitor for evidence of rebound hypocalcemia.

Interestingly, in case 1, the primary tumor was not identified. It was presumed that the neoplastic disease noted in the medial iliac and hypogastric lymph nodes was secondary to an anal sac adenocarcinoma, based on both location and histopathology results. Another similar case has been reported, in a dog with a retroperitoneal mass with a histopathological diagnosis of apocrine gland adenocarcinoma. This patient had no evidence of primary anal sac disease (14). Due to the rarity of this presentation, it is difficult to speculate on the significance of our inability to identify the primary tumor in this case. In a study of 21 dogs with metastatic cancer of unknown primary origin, 57% were carcinoma (15).

It is reasonable to believe that rebound hypocalcemia following surgical treatment of anal sac adenocarcinoma is relatively rare, and therefore not a significant risk consideration for most clinicians treating these patients. However, when it does occur it can lead to significant increases in hospitalization time and costs for owners and can be life-threatening to the patient. The authors believe it is essential to categorize this syndrome as an important post-operative complication to increase awareness and vigilance in monitoring patients for clinical hypocalcemia. In addition, caution should be exercised in regard to the use of pre-operative bisphosphonates to decrease circulating calcium levels when removal of a PTHrP secreting tumor is planned.

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References

Comparison of acetate tape impression, deep skin scraping, and microscopic examination of hair for therapeutic monitoring of dogs with juvenile generalized demodicosis: A pilot study

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Abstract — The standard method for diagnosis and therapeutic monitoring of dogs with demodicosis is microscopic examination of deep skin scrapings. Previous studies have compared deep skin scraping and microscopic hair examination to acetate tape impression with skin squeezing for the diagnosis of demodicosis but the latter has never been evaluated for therapeutic monitoring. The main purpose of this study was to evaluate acetate tape impression with skin squeezing as a therapeutic monitoring tool for dogs with juvenile onset generalized demodicosis. An area of skin with primary lesions for demodicosis was chosen and the 3 techniques were performed. The total number of mites including each of the Demodex canis life stages were recorded. This was done weekly until negative results were obtained. There were no significant differences in the total number of mites in the weekly counts between the deep skin scrapings and the acetate tape impressions with skin squeezing. Acetate tape impression with skin squeezing can be used for therapeutic monitoring of dogs with juvenile onset generalized demodicosis.

Résumé — Comparaison de l’impression sur ruban acétate, des grattages cutanés profonds et de l’examen microscopique du poil pour la surveillance thérapeutique des chiens atteints de démodicose généralisée juvénile : étude pilote. La méthode standard pour le diagnostic et la surveillance thérapeutique des chiens atteints de démodicose est l’examen microscopique des grattages cutanés profonds. Des études antérieures ont comparé des grattages cutanés profonds et l’examen microscopique du poil à l’impression sur ruban d’acétate avec le pincement de la peau pour le diagnostic de la démodicose, mais cette dernière méthode n’a jamais été évaluée pour la surveillance thérapeutique. Le but principal de cette étude consistait à évaluer l’impression sur ruban d’acétate avec pincement de la peau comme outil de surveillance thérapeutique pour les chiens atteints de démodicose généralisée juvénile. Une région de peau avec des lésions primitives pour la démodicose a été choisie et les trois techniques ont été réalisées. Le nombre total de mites, y compris chaque des stades de vie de Demodex canis, a été consigné. Cette technique a été employée une fois par semaine jusqu’à l’obtention de résultats négatifs. Il n’y avait aucune différence significative dans le nombre total de mites dans les numérotations hebdomadaires entre les grattages cutanés profonds et les impressions sur ruban d’acétate avec pincement de la peau. L’impression sur ruban d’acétate avec pincement de la peau peut être utilisée pour la surveillance thérapeutique des chiens atteints de démodicose généralisée juvénile.

(Traduit par Isabelle Vallières)

Introduction

Demodicosis is a common skin disease of the dog (1). Demodex mites are a normal part of the dog’s cutaneous microfauna and are transmitted from the bitch to puppies during the first days of life. The population of mites is under the control of the dog’s immune system (1,2). It is believed that canine juvenile demodicosis is a consequence of a genetic defect that leads to defective control of mite populations by the immune system (3). Deep skin scrapings (DSS) are the standard diagnostic test for canine demodicosis, although there...
are others, such as microscopic hair examination (ME) and acetate tape impressions (AI) with skin squeezing, which have different levels of sensitivity (4–8). Only DSS can be used for therapeutic monitoring (2); however, this is a painful procedure and some dogs may not allow it, so less painful techniques with the same sensitivity should be evaluated. The main objective of this prospective study was to evaluate AI with skin squeezing as an alternative to DSS for therapeutic monitoring of dogs with juvenile onset generalized demodicosis. The estimated total number of mites and their different life stages obtained by DSS, ME, and AI with skin squeezing in dogs with juvenile onset generalized demodicosis (JGD) were compared.

Materials and methods
Owners signed a consent form prior to having their dogs included in the study. Inclusion criteria for the study dogs were: dogs from 3 mo to 2 y of age, any breed, minimum weight of 2 kg, dogs with JGD (more than 4 lesions larger than 2.5 cm) (1) diagnosed by DSS, no underlying disease identified through the problem oriented medical record, blood cell count, biochemistry, and urinalysis. Exclusion criteria included any previous acaricidal therapy, aggressive dogs that didn’t allow sampling, and dogs with concomitant diseases. The elimination criteria included not attending the scheduled weekly appointment, lack of response to proposed acaricidal therapy, and adverse reaction to acaricidal therapy.

A diagnosis of demodicosis in study dogs was made by the finding of at least 1 *Demodex canis* mite (any life stage) in DSS from at least 3 different anatomical areas. The areas chosen for deep scraping were areas with primary lesions associated with demodicosis (erythema, follicular papules and pustules, and comedones). In all the dogs the presence of secondary pyoderma and/or yeasts was ruled out by cytology. At the beginning of the study all dogs were treated orally with fluralaner chewable tablets (Bravecto; MSD Animal Health, Kenilworth, New Jersey, USA), 25 to 56 mg/kg body weight (BW); a second dose was administered 3 mo later. Fluralaner was chosen because a single oral administration is highly effective against generalized demodicosis (9).

After diagnosis, new DSS, ME, and AI with skin squeezing were taken. Again, 3 different anatomical areas that had primary lesions for demodicosis were chosen and in the periphery of the lesion area (Figure 1) hairs were clipped, a few drops of mineral oil were applied onto the surface of the skin, and a DSS was performed until capillary bleeding was observed, following squeezing of the skin for 5 s. Adjacent to this area, microscopic hair examination was conducted using hemostatic forceps with protected ends, and finally, in the area adjacent to the site for ME, hairs were clipped and acetate tape (3M, St. Paul, Minnesota, USA) was placed on the skin and skin squeezing of the area was performed for 5 s. Each diagnostic technique was performed on an area of 1 cm².

Samples for DSS and ME were placed on separate glass slides, mixed with mineral oil and covered with a 20 mm × 20 mm coverslip. Acetate tape impressions with skin squeezing were placed directly on a slide (sticky side down). In DSS the entire surface of the coverslip was observed, in ME all hairs were observed, and in AI with skin squeezing an area of 20 mm × 20 mm was observed.

Samples were observed under a light microscope at 40×, 100×, and 400× magnifications. The total mite count and each life stage based on morphology (2) were identified and recorded for each diagnostic technique (Figure 2). This was performed every 7 d for the same lesions until negative results were obtained. Sampling was continued for 4 consecutive weeks after all techniques were negative for mites.

Data analysis
Normality of data was assessed using the Shapiro-Wilk test. Statistical significance was calculated by analysis of variance (ANOVA), followed by Tukey’s test for mean comparisons. *P*-values ≤ 0.05 were considered significant. All statistical analyses were performed using SPSS Statistics v23.0 software (IBM, Armonk, New York, USA).
Eight dogs were included in this study: 4 intact females, 2 neutered males, and 2 intact males. Breeds included 3 Chihuahuas, 1 American pit bull terrier, 1 Dachshund, and 3 mixed breeds. The ages of the dogs ranged from 5 mo to 14 mo, with a mean of 7 mo. All dogs were housed with the owners during the entire study.

At least 1 life stage of the *D. canis* mite was observed on day 0 in AI with skin squeezing of the 8 dogs previously diagnosed with juvenile onset generalized demodicosis by DSS. There were no significant differences in the total number of mites on day 0 (*P* = 0.147), week 1 (*P* = 0.346), week 2 (*P* = 0.884), week 3 (*P* = 0.417), and week 4 (*P* = 0.831) between DSS and AI with skin squeezing. The total number of mites was significantly lower (*P* < 0.05) in ME compared to DSS and AI with skin squeezing at all weeks except week 4 (*P* = 0.212 and *P* = 0.074, respectively) (Table 1).

On day 0, there were no significant differences in the number of adults (*P* = 0.531) (Figure 3) and nymphs (*P* = 0.852) (Figure 4) between DSS and AI with skin squeezing. The number of larvae (Figure 5) and eggs (Figure 6), however, was significantly higher (*P* < 0.05) on AI with skin squeezing compared to DSS. This difference remained until wk 2. On day 0, the number of adults, nymphs, larvae, and eggs was significantly lower (*P* < 0.05) in ME compared to DSS and AI with skin squeezing. On wk 3, no eggs were found by any of the techniques, adults were detected by all 3, and nymphs and larvae only in AI with skin squeezing. On week 4, no nymphs, larvae, or eggs were found by any of the techniques, only adults in DSS and AI with skin squeezing, with the difference being not significant (*P* = 0.831) (Figure 3). From week 5 until the end of the study all the techniques were negative for the presence of any life stage of the mite.

### Results

#### Table 1. Numbers of *Demodex canis* mites found in deep skin scrapings, microscopic hair examination, and acetate tape impressions with skin squeezing on day 0 (D0), week 1 (W1), week 2 (W2), week 3 (W3) and week 4 (W4). Data are expressed as mean ± SD for the 8 dogs in the study.

<table>
<thead>
<tr>
<th>Week</th>
<th>DSS (Mean ± SD)</th>
<th>ME (Mean ± SD)</th>
<th>AI (Mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>78.13 ± 14.91</td>
<td>20.50 ± 4.75</td>
<td>93.00 ± 23.20</td>
</tr>
<tr>
<td>W1</td>
<td>39.25 ± 11.51</td>
<td>8.25 ± 2.49</td>
<td>45.88 ± 10.97</td>
</tr>
<tr>
<td>W2</td>
<td>10.38 ± 4.00</td>
<td>0.88 ± 0.99</td>
<td>11.25 ± 4.89</td>
</tr>
<tr>
<td>W3</td>
<td>2.88 ± 1.15</td>
<td>0.13 ± 0.35</td>
<td>3.50 ± 1.20</td>
</tr>
<tr>
<td>W4</td>
<td>0.38 ± 0.52</td>
<td>0 ± 0</td>
<td>0.50 ± 0.53</td>
</tr>
</tbody>
</table>

Means with different superscripted letters in rows are significantly different. DSS — deep skin scraping; ME — microscopic hair examination; AI — acetate tape impression.

#### Figure 3. Mean number of adults observed in deep skin scrapings, microscopic hair examinations, and acetate tape impression with skin squeezing on day 0, week 1, week 2, week 3, and week 4. Columns with different letters in the same time frame are significantly different.

#### Figure 4. Mean number of nymphs observed in deep skin scrapings, microscopic hair examinations, and acetate tape impression with skin squeezing on day 0, week 1, week 2, week 3, and week 4. Columns with different letters in the same time frame are significantly different.

In week 3 of this study, DSS of the 8 dogs was negative for nymphs, larvae, and eggs while in 7 dogs AI with skin squeezing detected nymphs, 1 in each of the 7 dogs, 2 of which also had larvae, 1 in each dog. In wk 4, we no longer observed any life stage of the mite in 3 dogs by DSS or AI with skin squeezing; in 2 dogs which were negative for all of the life stages of the mite by DSS were positive by AI with skin squeezing (1 adult mite in each dog); in 1 dog we observed an adult mite in DSS but AI with skin squeezing was negative. For the 2 remaining dogs 1 adult mite in DSS and 1 adult mite in AI with skin squeezing in each dog were observed. Even when the number of mites was very low, AI with skin squeezing was still able to detect juvenile forms of the mite, giving a more realistic scenario of the mite.

### Discussion

The results from this study suggest that AI with skin squeezing can be used for therapeutic monitoring of dogs with JGD. To the best of our knowledge, this is the first study to investigate and describe AI with skin squeezing as a monitoring technique for JGD. Therapeutic monitoring in a patient with demodicosis consists of observing a decrease in the number of mites obtained by DSS in a certain period of time until the skin scrapings are negative (1).
population inhabiting the skin of the diseased dogs and the response to treatment.

Acetate tape impression with skin squeezing has been evaluated previously for the diagnosis of generalized demodicosis with findings indicating significant differences in the total number of mites, more specifically adults and nymphs, compared to DSS (5). In our study, the total number of mites was greater with AI with skin squeezing than with DSS, but the difference was not statistically significant. The number of larvae and eggs was significantly higher with AI with skin squeezing than with DSS. These 2 findings could suggest that the most important step in DSS (as also with AI) is the skin squeezing to expel the mites from the hair follicle and not the scraping until a slight capillary bleeding is obtained. In addition, the scraping action could damage the more juvenile forms of the mite preventing their visualization under the microscope; this doesn’t happen when we use AI with skin squeezing (author personal observation).

Acetate tape impression with skin squeezing offers advantages over DSS; it is less traumatic for the patient and can be used in anatomical areas where performing DSS is very difficult or the possibility of injuring the patient is high, for example, the periocular or interdigital area. One disadvantage of AI with skin squeezing is that we cannot observe if the mites are alive or dead, and this has been proposed as a way of knowing if the administered treatment is effective (10).

Microscopic hair examination has been evaluated as an alternative for the diagnosis of generalized demodicosis showing a sensitivity close to that of DSS (4), although it is considered that this technique loses any value once the treatment has started and, therefore, it is not useful for therapeutic monitoring (2). This is in accordance with the results of our study since ME of the 8 dogs previously diagnosed with JGD by DSS showed at least 1 life stage of the mite on day 0, although the number of all life stages of the mite was lower than with the other 2 techniques evaluated.

During week 2 no life stages of the mite were observed in 3 dogs with ME, although mites were observed with DSS and AI with skin squeezing. If only the results of ME are taken into account in these dogs, the duration of the treatment would have been inadequate and, therefore, the possibility of relapses, greater (1). The same situation occurred in week 3, during which mites were observed by ME in only 1 dog, while with the other 2 techniques, mites were observed in all 8 dogs.

One limitation of the study was the small number of dogs; a study with a larger number of dogs should be initiated. Also, it would be interesting to study the AI technique in dogs with adult onset demodicosis and find out if the results are similar to those seen herein.

In conclusion, AI with skin squeezing can be used to diagnose and monitor response to treatment in dogs with JGD. The total number of mites observed was higher in AI with skin squeezing, followed by DSS and, finally, ME, in all weeks. Acetate tape impression with skin squeezing offers advantages over DSS since it is less traumatic to the dog and can be used in anatomical areas where DSS may be difficult perform.

References
5. Pereira AV, Pereira SA, Gremiao IDF, Campos MP, Ferreira AMR. Comparison of acetate tape impression with squeezing versus skin...

Answers to Quiz Corner
Les réponses du test éclair

1. D) Mirror image is the term used for the ultrasound artifact that results in the liver appearing to be on both the thoracic and abdominal sides of the diaphragm.
   D) Image miroir est le terme utilisé pour désigner l’artéfact échographique qui a pour résultat de faire apparaître le foie du côté thoracique et du côté abdominal du diaphragme.

2. A) All of the other choices have been well-characterized as non-dose-dependent side effects.
   A) Tous les autres choix ont été bien identifiés comme étant des effets secondaires non dépendants de la dose.

3. A) Dilated cardiomyopathy is diagnosed with an echocardiogram.
   A) Le diagnostic de la cardiomyopathie dilatée se confirme par l’échocardiogramme.

4. D) Functional adenoma (hypertrophy) or adenomatous hyperplasia of the pituitary pars intermedia is associated with a clinical syndrome of hirsutism.
   D) L’adénome fonctionnel (hypertrophie) ou hyperplasie adénomateuse de la partie intermédiaire de l’hypophyse est associé au syndrome clinique d’hirsutisme.

5. C) It is not safe for cows that are this lame to walk, especially on cement, because they often fall and injure themselves. Neither is it safe to have limbs restrained while standing, because they typically fatigue and become recumbent during the examination, which can also lead to injury. Hoof and limb examination is only safe and effective in lateral recumbency if the cow is sedated, although analgesics are useful in alleviating pain. Restraint of the limb with ropes may also be recommended if low or moderate xylazine doses are used. Limb restraints are less likely to be required if a tranquilizer such as ketamine is also given.
   C) Il n’est pas sécuritaire pour les vaches qui souffrent de cette boiterie de marcher, spécialement sur le ciment, parce qu’elles tombent souvent et se blessent. Il n’est pas non plus sécuritaire de faire la contention des membres lorsque les vaches sont debout, parce qu’elles se fatiguent et peuvent tomber durant l’examen, ce qui peut causer des blessures. L’examen des ongles et des membres est seulement sécuritaire et efficace en décubitus latéral, si la vache est sous sédation, quoique les analgésiques sont utiles pour atténuer la douleur. La contention des membres avec des câbles peut aussi être recommandée, si on utilise des doses faibles à modérées de xylazine. La contention des membres est moins susceptible d’être nécessaire si un tranquillisant comme la kétamine est aussi administré.
Modified balloon-catheter-assisted closed anal sacculectomy in the dog: Description of surgical technique

Devon Diaz, Sarah Boston, Adam Ogilvie, Ameet Singh, Owen Skinner

Abstract — The aim of this report is to describe a modified Foley catheter technique for anal sacculectomy. A standard approach used for a closed anal sacculectomy was performed. The duct of the anal sac was then freed from the surrounding tissues and ligated. The duct was transected lateral to the ligature and a purse string suture placed. The anal sac balloon catheter was inserted through the duct into the anal sac and the purse string was tightened. Once inflated, the catheter was then used as a handle to facilitate manipulation and dissection of the anal sac from surrounding tissues. This technique permits circumferential dissection of the anal sac with good visualization, accuracy, and control, especially at the medial portion of the anal sac adjacent to the rectum. This technique can be considered for application to cases of chronic anal sacculitis and small anal gland adenocarcinomas.

Résumé — Sacculectomie anale fermée assistée par ballon cathéter modifié chez le chien : description de la technique chirurgicale. Le but de ce rapport consistait à décrire une technique de cathéter de Foley modifiée pour la sacculectomie anale. Une approche standard utilisée pour une sacculectomie anale fermée a été réalisée. Le canal du sac anal a ensuite été libéré des tissus environnants et ligaturé. Une dissection transversale du canal a été effectuée latéralement à la ligature et une suture en cordon de bourse a ensuite été réalisée. Le ballon cathétér du sac anal a été inséré par le canal du sac anal et le cordon de bourse a été resserré. Une fois gonflé, le cathéter a ensuite été utilisé comme une poignée pour faciliter la manipulation et la dissection du sac anal des tissus environnants. Cette technique permet la dissection circonférentielle du sac anal avec une bonne visualisation, de l’exactitude et du contrôle, particulièrement à la portion médiale du sac anal adjacent au rectum. Cette technique peut être considérée pour application à des cas de sacculite anale chronique et à de petits adénocarcinomes des glandes anales.

Introduction

Anal sacculectomy is a procedure that is performed to either relieve clinical signs associated with chronic anal sacculitis or resect anal gland adenocarcinoma (1). Both open and closed techniques have been described, with an open technique being associated with an increased rate of complications (2). The external anal sphincter and rectum are intimately associated with the anal sacs, which can make the dissection for sacculectomy challenging (3). A technique has been reported in which a Foley catheter is inserted into the anal sac and inflated to allow for improved anatomic definition of the anal sac and to facilitate the dissection (4). Although the use of a Foley catheter is helpful in anal sacculectomy, in the authors’ hands, the dissection at the medial aspect of the anal sac and duct can still be challenging because of lack of visualization. Using the Foley catheter technique, most of this dissection of the caudomedial aspect of the anal sac is performed with limited visualization because the anal sac is tethered by the anal sac duct. The aim of this report is to describe a modification of the Foley catheter technique, using an anal sac balloon catheter (Anal Sac Balloon Catheter; MILA International, Florence, Kentucky, USA) to aid in visualization and facilitating dissection of the medial dissection plane between the rectum and anal sac.

Materials and methods

A medium-sized mixed breed dog previously euthanized for reasons unrelated to this study was used to demonstrate the technique. The dog was positioned in a perineal position with
Figure 1. A – Crile forceps were inserted into the left anal sac duct opening to confirm the location of the anal sac duct. B – A curvilinear skin incision was made in a dorsoventral direction over the anal sac. C – The duct of the anal sac was isolated using blunt dissection. D – The duct was ligated routinely using 3-0 polydioxanone near the most distal aspect of the anal sac duct. E – The duct was then severed lateral to the ligature. A purse-string suture (arrowhead) was placed using 3-0 polydioxanone to secure the anal sac catheter once in place. Once the suture is placed, the hemostat can be removed to facilitate placement of the anal sac balloon catheter. F – The 6-French anal sac balloon catheter was placed through the severed duct and into the anal sac. G – The anal sac balloon catheter was inflated with 2 to 3 mL of saline and the purse-string suture was then secured with a square knot (arrowhead). H – The catheter was then used as a handle to facilitate manipulation and dissection of the anal sac from the external anal sphincter with blunt dissection, remaining as close to the anal sac as possible.
the tail retracted cranio-dorsal. The anal sacs were expressed and flushed. The perianal skin was routinely clipped and tonsil sponges (Tonsil Sponges; First Aid Bandage Company, New London, Connecticut, USA) were placed in the rectum to minimize fecal contamination. A 6-French anal sac balloon catheter was prepared by inflating it with 2 to 3 mL of saline to ensure proper inflation without leakage. The dog was then used to illustrate the modified surgical technique.

**Results**

Crile forceps were used to confirm the location of the anal sac duct (Figure 1A). A curvilinear skin incision was made in a dorsoventral direction, over the lateral 2/3 of the anal sac, lateral to the duct and anus (Figure 1B). Initially, the duct of the anal sac was localized using blunt dissection (Figure 1C). Once the duct was freed of surrounding tissues, the Crile forceps were removed from the duct and 2 mosquito hemostats were placed on the duct. The duct was ligated routinely using 3-0 polydioxanone (PDSII; Ethicon, Somerville, New Jersey, USA) near the most medial mosquito hemostat (Figure 1D). The duct was then severed between the ligature and remaining mosquito hemostat. The medial hemostat was then removed. A purse-string suture was placed using 3-0 polydioxanone suture, just proximal to the remaining mosquito hemostat (Figure 1E). The proximal duct and anal sac were grasped with forceps and the hemostat was removed. The anal sac balloon catheter was placed through the severed duct and into the anal sac (Figure 1F). The purse-string suture was tightened around the catheter, with a single throw placed before inflation of the anal sac catheter balloon. The purse-string suture was then secured with a square knot (Figure 1G). The catheter was then used as a handle to facilitate manipulation and dissection of the anal sac from the external anal sphincter with blunt dissection, remaining as close to the anal sac as possible (Figure 1H). The anal sac was completely removed (Figure 2).

**Discussion**

In the authors’ opinion, this simple modification of the closed technique for anal sacculcectomy provides improved control during dissection. The previously reported closed technique involves dissection around the entire anal sac until only the duct remains. The challenge of that technique is that the dissection of the medial aspect of the anal sac just caudal to the duct is blind and the anal sac is adjacent to the rectum in this location. The technique reported here allows the anal sac to be freed from the duct. This allows for circumferential dissection around the sac with improved visualization and control. The catheter can be used to lever the anal sac laterally, away from the rectum. Care should still be taken when dissecting the medial aspect of the anal sac in order to avoid traumatizing the caudal rectal artery. This technique can be applied to cases of chronic anal sacculitis and anal gland adenocarcinoma. However, it may not be helpful in cases of large tumors where the duct and gland are obliterated, anal duct atresia, anal duct stenosis, and ruptured anal sac associated with abscessation.

In using this technique when the initial ligation of the anal sac duct is performed, care should be taken to ensure that the duct is transected close to its ostium. If the duct is ligated directly over the junction of the duct and anal sac, failure of the anal sac to contain the balloon of the anal sac catheter is possible. Adequate initial dissection and visualization around the duct is crucial in order to avoid this. Care should also be taken during initial dissection not to damage the duct itself. By keeping dissection as close to the ostium as possible, the risk of inadvertent trauma to the anal sac or cranial aspect of the duct can be minimized.

During dissection of the anal sac from the surrounding tissues, the reported technique employs the use of the anal sac balloon catheter. This purpose-made catheter is preferable to the Foley catheter, which has also been reported to aid in anal sacculcectomy (4) because the anal sac balloon catheter terminates at the level of the balloon, whereas the Foley catheter has a small length of catheter beyond the balloon which can make placement of the catheter more challenging. The use of a balloon catheter also helps to distribute tension over the entire surface of the anal sac. This distribution of load may help to reduce the likelihood of tearing the anal sac, resulting in surgical site contamination. Diseased glands may be more friable and often are more difficult to dissect out making the risk of excising into disease tissue higher. It is imperative that the anal glands are expressed before surgery in order to minimize the chances of surgical site contamination if the sac were to rupture. In addition, the catheter is used to tether the anal sac during the critical medial dissection where it is adhered to the rectal serosa. The tension applied using this technique may allow for improved dissection in this critical area.

In comparison to the traditional closed technique, it is possible that the technique described in this report may have a higher risk of surgical field contamination. This is due to the insertion of the anal sac balloon catheter into the duct and anal sac after the initial duct transection. In order to minimize this risk, the surgeon may elect to place gauze below the transected...
duct to contain contamination if a leak of anal sac contents were to occur as the catheter is inserted. Additionally, grasping the transected duct in a manner in which to decrease the amount of gravity-dependent flow of anal sac contents may also be beneficial. Currently there is no literature available to permit a conclusion about whether rupture of an anal sac during surgery is associated with higher rates of post-operative infection. The current literature cites the most common post-operative complications as: damage to either the caudal rectal nerves or anal sphincter resulting in fecal incontinence (often temporary), scooting, inflammation, excessive drainage from the surgical site, acute seroma formation, dehiscence, and chronic fistula and stricture formation (5,6).

In comparing the traditional closed technique and this modification, the relative trauma to the external anal sphincter should be comparable. Whether the dissection is taking place in a lateral to medial direction versus a more circumferential dissection, the fact remains that one must dissect as close to the anal sac as possible without rupturing the sac in order to minimize the trauma to the surrounding tissues. Prospective clinical evaluation should be considered to assess whether this technique provides a clinical benefit and if there are any adverse effects associated with this technique.

References


Book Review

Bovine Surgery and Lameness, 3rd edition


Initially I questioned the usefulness of this book. It is definitely written from a UK perspective. At first glance, I saw a recommendation for Clenbuterol (banned in food animals in Canada), references to “crushes,” and decided that it would be of little use to me!

Nevertheless, I persisted... And discovered that this is a well laid out little guide that deserves a place in my overcrowded truck.

The chapters are well-organized and clear. It covers everything from anesthesia and fluid therapy to surgery. The surgery chapters are organized by region — head and neck, abdominal, urogenital, etc. There is an excellent chapter on lameness at the end. Throughout the chapters there are highlighted areas with helpful tips and discussions of pertinent background information. Each procedure has indications, restraint, equipment, technique, and complications listed. There are also very good line drawings of the pertinent anatomy.

The procedures covered range from a basic caesarean section to more advanced surgical techniques. I think that it would be useful for everyone from a student or new veterinarian learning the ropes to a more experienced practitioner that wants to try something new, or needs a reminder of a surgery they haven’t done in a while.

The chapter on musculoskeletal conditions and lameness is very good. It has up-to-date information on digital dermatitis and toe-tip necrosis. There are excellent photographs of diseased feet in cross section. This chapter covers everything from joint ill to claw amputations.

The book also contains a link to a website with video and annotated documents of videos. The videos are well done with good pictures and video footage.

Overall, this is a text that I will use myself and to teach students. I do think that when following the recommendations, one will need to make some adjustments. Suture size, for example, is in metric. There is a conversion chart in the front to facilitate this. The recommendations for drugs in particular will be of somewhat limited use given the continental variations.

Reviewed by Anne Rogers, DVM, Edson Veterinary Clinic, Edson, Alberta.
Heartworm infection in domestic dogs in Canada, 1977–2016: Prevalence, time trend, and efficacy of prophylaxis

Erin McGill, Olaf Berke, J. Scott Weese, Andrew Peregrine

Abstract — Dirofilaria immitis (heartworm) is a mosquito-borne parasite that primarily infects domestic and wild canids. The objectives of this study were to i) determine if there has been a temporal change in prevalence of heartworm infection among domestic dogs in Canada from 1977 to 2016; ii) explore the spatial extension of heartworm across Canada using choropleth maps; and iii) assess the efficacy of preventive drugs using the estimated “Attributable Fraction Exposed.” Heartworm surveys that collected data from 1977 to 2010 and serological laboratory data from 2007 to 2016 were analyzed. The data depicted a decrease in heartworm prevalence, both nationally and provincially, from 1977 to the early 2000s. However, an increase in prevalence was identified for tested dog populations in Manitoba and Quebec from 2007 to 2016. Chemoprophylaxis was associated with an estimated 93.0% [95% confidence interval (CI): 92.85, 93.3] reduction of heartworm infections in domestic dogs in Canada from 1977 to 2010.


(Traduit par Isabelle Vallières)

Can Vet J 2019;60:605–612

Introduction

Dirofilaria immitis, also known as heartworm, is a mosquito-borne parasite that primarily infects domestic and wild canids (1). Heartworm infection can be acute or chronic, and the disease can be fatal (2). Heartworm can also be transmitted to humans by mosquitoes, but human infections are rare (3).

Mosquitoes are the only known intermediate host of D. immitis. The rate of parasite development from microfilariae to the infective third-stage larvae is influenced by temperature. For the parasite to be transmitted from a mosquito to a dog there is a threshold temperature of 14°C that is required to support larval maturation to the infective stage and a linear relationship exists between the rate of development and temperature from 18°C to 34°C (4). The amount of heat required for microfilariae to reach that stage is 130 heartworm development units (HDUs) and is calculated using the daily sum of degrees Celsius above the threshold (4,5). In Canada, the transmission period for heartworm has historically been determined by summing

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daily HDUs from May 6th (date of earliest blood feeding for *Aedes stimulans* — an early season vector) until 130 HDUs are reached; this is regarded as the start of transmission season for that year (4). The end of the transmission period was determined by looking at the last day 130 HDUs were accumulated within a 30-day period based on the late season vector *Aedes vexans* (4). The start of the transmission season was not limited to 30 d because the early vector has a long life-span and can be found in August (4). An assumption with these calculations was that mosquitoes do not overwinter (4). Based on the most southern region of Ontario, for the years 1957 to 1986, the transmission period for Canada was estimated to be from June 1st to October 9th (4). As a result, monthly heartworm preventive medication is suggested to be given from June 1st to November 1st although the treatment on June 1st is likely not needed as prevenitives are approved with 1-month’s reach-back activity (2).

Heartworm infection was first considered to be endemic to Canada in the 1970s and since then annual heartworm testing has been conducted at many veterinary practices (6). Historically, the risk in Canada was considered highest in southern Ontario, with 2 other foci in southern Manitoba and southern Quebec (6). For many years mail-back surveys were sent to veterinary clinics across Canada requesting information on the heartworm infection status of dogs, cats and “other” animals. These annual surveys were conducted from 1977 to 2010 and collected data from 1977 to 1989, 1991, 1996 to 1998, 2000 to 2002, and 2010. The surveys reported an aggregated prevalence of 3.7% for all dogs infected with heartworm and assessed by a veterinarian, with a prevalence range from 2.4% in 1977 to 0.15% in 2010. However, heartworm prevalence among dogs not on preventive medication was 0.7% in 2010 (6,7).

In Canada, heartworm is considered a rare infection compared to some other countries. For example, randomly selected companion dogs in Grenada displayed a prevalence of 25.3% (8). As indicated, southern Ontario has historically been one of the foci of heartworm infection in Canada; however, the risk of infection across Ontario has been debated as heartworm maturation within mosquitoes requires sustained warm temperatures that are uncommon in more northern regions of the country (9). The last nationwide mail-back survey in Canada was conducted in 2010. Anecdotally, heartworm risk may have changed in Canada since 2010 due to a changing climate, which is expected to increase prevalence and extend endemic areas (10). For example, climate change has been associated with the emergence of the parasite in Italy and parts of the United States (3,11). If climate change is implicated in heartworm infections in these countries, the same could hold true for Canada. For example, Ontario has seen an increase in the number and extent of heatwaves (summers 2010 to 2012), i.e., ideal weather conditions for the development of heartworm in mosquitoes (12).

The goal of this study, therefore, was to estimate the prevalence of heartworm infection, and to study its geographic and temporal distribution in Canada from 1977 to 2016. The 3 objectives were to i) determine if there has been a temporal trend in heartworm infection prevalence among domestic dogs in Canada; ii) explore the spatial extension of heartworm infection across Canada using choropleth maps; and iii) assess the efficacy of preventive drugs using the estimated Attributable Fraction Exposed (AFE).

**Materials and methods**

Data on the prevalence of heartworm infection in Canadian companion dogs were obtained from 2 sources. The first data set was retrieved from the Ontario Veterinary College (OVC) archives. It consisted of survey data collected for the years 1996, 1997, 1998, 2000, 2001, 2002, and 2010 (13). Additional, similar data from the years 1977 to 1989 and from 1991 were extracted from surveys conducted earlier (7). The surveys described the number of cases per province (or grouped provinces by location, e.g., Atlantic Provinces), the number of dogs tested, the number of dogs on preventive medication diagnosed with heartworm, and the number of dogs on preventive medication. Surveys were sent to provincial, federal, industrial, institutional veterinarians (e.g., veterinary colleges) as well as mixed and small animal practitioners (7,13). The surveys collected annual data, except for the 2010 survey which collected responses from 2010 and early 2011 (13). The definition of heartworm infection was determined by veterinarians participating in the surveys; most (~85%) used blood tests to determine heartworm infection status (7,13). Data for Quebec were not available for the years 1996 to 1998 and 2000 to 2002. For privacy reasons, only the location of the veterinary clinics was provided. Information on the patient or the owner, including confirmatory diagnostics and clinical outcome for the patient were not available. The surveys included information on the travel history of only case dogs.

The second dataset analyzed was provided by IDEXX Laboratories Canada. The data were collected from 2007 to 2016 and were a combination of *D. immitis* antigen test results performed in clinics and results from submissions to the IDEXX Laboratory. The years 2007 and 2016 were partial years; 2007 had submissions from March to December and 2016 had submissions from January to July. Three heartworm blood antigen tests were used: the SNAP 3Dx, SNAP 4Dx, and SNAP 4Dx Plus tests. The SNAP 4Dx test was released in 2007 and used concurrently with the 3Dx test for the years 2007 to 2011. The SNAP 4Dx Plus test was released in 2012 and that year all 3 tests were used. From 2013 onward only the 4Dx Plus Test was used. Dog signalment, test date, and postal code of the veterinary clinic were provided. Information on the patient or the owner, including travel history, confirmatory diagnostics, preventative usage history and clinical outcome for the patient were not available.

The survey data were used to estimate the canine heartworm prevalence for Canada and separately by province, when/where possible. The denominator for Canada was all dogs tested that year, which was available for all years included. Provincial estimates of prevalence depended on whether the published survey results that year included a breakdown of the reported positive dogs and number of dogs tested for that province. The laboratory data were used to estimate the prevalence of heartworm infection in Canada, and by individual province. To investigate
The reported sensitivity and specificity of the 4Dx Plus Test are 99.0% and 99.3%, respectively (15). The true prevalence for the study population was estimated using the Rogan and Gladen estimator based on the apparent laboratory prevalence and the sensitivity and specificity of the antigen test (16,17). The predictive value for dogs testing positive was also estimated (17). The prevalence referred to in this paper is the estimated apparent prevalence of heartworm infection and will hereafter be referred to as prevalence. It should be recognized that the apparent prevalence may differ from the true prevalence due to false negatives or false positives.

To visualize national temporal trends (as indicated by the trend test), sample size weighted trend lines based on smoothing splines were added to respective scatterplots for the survey data and the laboratory data separately. Provincial trend lines for Manitoba, Ontario, and Quebec were added to the scatterplots.

To visually display the provincial prevalence estimates for both survey and laboratory data, a boundary map file was constructed that outlined the country and provincial borders. The boundary file for Canada and the province boundaries were retrieved from Statistics Canada for the 2011 census (18). The boundary file projection was converted from GCS North America 1983 to Universal Transverse Mercator 15N for better visualization of the provinces’ landmass. The denominator was not consistent across provinces; thus, Empirical Bayesian

### Table 1. Descriptive summary of heartworm survey data collected from 1977 to 2010.

<table>
<thead>
<tr>
<th>Province</th>
<th>Year range</th>
<th>Sample size range</th>
<th>Mean sample size</th>
<th>Mean case size</th>
<th>Temporal trend</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>British Columbia</td>
<td>1981–2010</td>
<td>124–20 570</td>
<td>3981</td>
<td>7</td>
<td>Not significant</td>
<td>0.26 (0.23, 0.30)</td>
</tr>
<tr>
<td>Alberta</td>
<td>1981–2010</td>
<td>21–9959</td>
<td>2973</td>
<td>3</td>
<td>Significant decrease</td>
<td>0.11 (0.09, 0.15)</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>1981–2010</td>
<td>76–822</td>
<td>333</td>
<td>1</td>
<td>Significant decrease</td>
<td>0.25 (0.15, 0.41)</td>
</tr>
<tr>
<td>Manitoba</td>
<td>1981–2010</td>
<td>1074–23 192</td>
<td>8360</td>
<td>29</td>
<td>Significant decrease</td>
<td>0.34 (0.31, 0.37)</td>
</tr>
<tr>
<td>Ontario</td>
<td>1981–2010</td>
<td>28 732–289 289</td>
<td>184 340</td>
<td>576</td>
<td>Significant decrease</td>
<td>0.31 (0.30, 0.32)</td>
</tr>
<tr>
<td>Quebec</td>
<td>1981–2010</td>
<td>252–48 301</td>
<td>16 955</td>
<td>50</td>
<td>Significant decrease</td>
<td>0.30 (0.28, 0.33)</td>
</tr>
<tr>
<td>New Brunswick</td>
<td>1981–2010</td>
<td>30–1729</td>
<td>722</td>
<td>1</td>
<td>Not significant</td>
<td>0.10 (0.06, 0.17)</td>
</tr>
<tr>
<td>Nova Scotia</td>
<td>1981–2010</td>
<td>101–46 85</td>
<td>1421</td>
<td>2</td>
<td>Significant decrease</td>
<td>0.10 (0.07, 0.15)</td>
</tr>
<tr>
<td>Prince Edward Island</td>
<td>1981–2010</td>
<td>26–136</td>
<td>65</td>
<td>0</td>
<td>Not significant</td>
<td>0.36 (0.14, 0.93)</td>
</tr>
<tr>
<td>Newfoundland</td>
<td>1981–2010</td>
<td>3–154</td>
<td>51</td>
<td>1</td>
<td>Significant decrease</td>
<td>1.1 (0.59, 1.0)</td>
</tr>
</tbody>
</table>

Canada: 1977–2010 16 563–419 381 197 203 622 Significant decrease 0.32 (0.31, 0.32)


1 Year range that provinces provided data. Survey was not sent out every year, and some years there were provinces which did not return the survey.

2 Range of minimum to maximum sample size per province for the years data were supplied.

3 Mean sample size calculated as the cumulative n = sample size, divided by year range data were obtained from the province.

4 Mean case size calculated as the cumulative k = cases, divided by the year range data were obtained from the province.

5 Result of Cochran-Armitage trend test, either significant or not significant at the α = 0.05 level.

6 Raw aggregated prevalence estimates (%) that were smoothed to create the choropleth maps, 95% CI in brackets.

### Table 2. Descriptive summary of diagnostic heartworm test (SNAP 3Dx, 4Dx, and 4Dx Plus Test) results collected in a diagnostic laboratory database from 2007 to 2016.

<table>
<thead>
<tr>
<th>Province</th>
<th>Year range</th>
<th>Range of sample size</th>
<th>Mean sample size</th>
<th>Mean case size</th>
<th>Temporal trend</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>British Columbia</td>
<td>2007–2016</td>
<td>11–1135</td>
<td>543</td>
<td>1</td>
<td>Not significant</td>
<td>0.13 (0.06, 0.27)</td>
</tr>
<tr>
<td>Alberta</td>
<td>2007–2016</td>
<td>7–1222</td>
<td>718</td>
<td>1</td>
<td>Not significant</td>
<td>0.19 (0.12, 0.33)</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>2008–2016</td>
<td>0–163</td>
<td>57</td>
<td>0</td>
<td>Not significant</td>
<td>0.22 (0.04, 1.0)</td>
</tr>
<tr>
<td>Manitoba</td>
<td>2007–2016</td>
<td>1050–11 560</td>
<td>8057</td>
<td>28</td>
<td>Significant increase</td>
<td>0.35 (0.31, 0.40)</td>
</tr>
<tr>
<td>Ontario</td>
<td>2007–2016</td>
<td>3782–136 581</td>
<td>66 097</td>
<td>76</td>
<td>Significant decrease</td>
<td>0.12 (0.11, 0.12)</td>
</tr>
<tr>
<td>Quebec</td>
<td>2007–2016</td>
<td>7–17 028</td>
<td>10 378</td>
<td>28</td>
<td>Significant increase</td>
<td>0.27 (0.24, 0.30)</td>
</tr>
<tr>
<td>New Brunswick</td>
<td>2007–2016</td>
<td>6–591</td>
<td>242</td>
<td>0</td>
<td>Not significant</td>
<td>0.16 (0.06, 0.42)</td>
</tr>
<tr>
<td>Nova Scotia</td>
<td>2007–2016</td>
<td>29–1456</td>
<td>713</td>
<td>1</td>
<td>Not significant</td>
<td>0.18 (0.10, 0.31)</td>
</tr>
<tr>
<td>Prince Edward Island</td>
<td>2013–2015</td>
<td>0–1</td>
<td>0</td>
<td>0</td>
<td>Not significant</td>
<td>0 (0, 1.0)</td>
</tr>
<tr>
<td>Newfoundland</td>
<td>2007–2016</td>
<td>0–53</td>
<td>30</td>
<td>0</td>
<td>Not significant</td>
<td>0.81 (0.22, 1.0)</td>
</tr>
<tr>
<td>Yukon</td>
<td>2011–2015</td>
<td>0–5</td>
<td>2</td>
<td>0</td>
<td>Not significant</td>
<td>0 (0, 1.0)</td>
</tr>
</tbody>
</table>

Canada: 2007–2016 4893–166 904 86 822 136 Not significant 0.16 (0.15, 0.17)

Source: IDEXX Laboratories Canada Corp.

1 Year range that SNAP 3Dx, 4Dx and 4Dx Plus Tests were submitted for laboratory testing for that province.

2 Range of minimum to maximum sample size per province for the years data were supplied.

3 Mean sample size calculated as the cumulative n = sample size, divided by year range data were obtained from the province.

4 Mean case size calculated as the cumulative k = cases, divided by the year range data were obtained from the province.

5 Result of Cochran-Armitage trend test, either significant or not significant at the α = 0.05 level.

6 Raw aggregated prevalence estimates (%) that were smoothed to create the choropleth maps, 95% CI in brackets.
Smoothing was used to internally standardize the differences in sample size across provinces (19–21). The annual prevalence was smoothed for each province and the smoothed prevalence estimates were aggregated over time using the mean to create a choropleth map for each dataset.

Geographic locations of veterinary clinics with laboratory submissions were extracted as centroids using Canadian postal code area information (22). The clinic locations were overlaid as points on top of the choropleth map of the smoothed prevalence. Point sizes were weighted by respective sample sizes (i.e., the number of reported tests).

The estimated Attributable Fraction Exposed (AFe) was estimated from the survey data to examine the efficacy of prophylaxis in preventing heartworm infection using the equation:

$$\text{AFe} = \frac{p(D|E=1) - p(D|E=0)}{p(D|E=1)}$$

Where: D stands for infection and E represents exposure and the positive and negative symbols explain the status (23). The AFe estimates the proportion of infection among a population that is due to an exposure (the assumption being the relationship is causal) (23). If exposures, i.e., prophylaxis, are negatively associated with infection, the AFe estimates the “lack of exposure” to the protective factor as increasing the risk (23). Therefore, the exposed population were dogs not on heartworm preventive medication and the unexposed population were dogs on preventive medication. The assumption for this study is that all parasites are drug susceptible, and that preventive medications were properly administered. The national annual efficacy was estimated by averaging the AFe for each province and year.

All data analyses were conducted in R and RStudio using a significance level of $\alpha = 0.05$ (24,25). The choropleth maps were created in ArcGIS (26).

**Results**

The heartworm prevalence for dogs in Canada in 1977 was estimated to be 2.4% (95% CI: 2.2, 2.6) and for 2010 (the last survey year) estimated to be 0.15% (95% CI: 0.14, 0.17). There was no information on the number of dogs on preventive medication in 1977 but 16% of the veterinarians who had participated in the 1977 survey said they recommended a preventive program for their clients (27). In contrast, the 2010 survey reported that 83% of dogs were on preventive medication (13). The prevalence based on laboratory data in 2015 was estimated to be 0.17% (95% CI: 0.16, 0.20), and for the partial year of 2016 (months January to July) estimated at 0.12% (95% CI: 0.10, 0.14). Using the laboratory data, the aggregated prevalence for all dogs tested from 2007 to 2016 was highest in Manitoba at 0.35% (95% CI: 0.31, 0.40). The aggregated prevalence for all dogs tested from 2007 to 2016 for Ontario was estimated to be 0.12% (95% CI: 0.11, 0.13), and the aggregated prevalence for all dogs tested from 2007 to 2016 for Quebec was estimated to be 0.27% (95% CI: 0.24, 0.31).

The surveys consistently had a larger sample size (Tables 1 and 2) than the laboratory register; however, the laboratory annual sample size steadily increased from 8082 samples in 2008 to 181 205 samples in 2015. Notably, most (75% to 90%) data were collected from dogs residing in the province of Ontario (Tables 1 and 2).
There were differences in information provided between survey and laboratory data. Veterinarians from the territories did not mail back surveys and only 1 veterinarian from the Yukon submitted blood samples to the diagnostic laboratory. The surveys reported national heartworm information starting in 1977, but it was not until 1981 that the surveys displayed information at a provincial level.

Figure 1 is a proportional symbol or “bubble” plot showing the annual prevalence of heartworm across Canada, where the bubble size represents the sample size. Additional smoothing lines visualize time trends for selected provinces: Ontario, Manitoba, and Quebec. These 3 provinces were selected because they had the largest sample sizes and had previously been suggested as provinces with an elevated risk of heartworm infection in companion dogs (6). The Cochran-Armitage trend test suggested a temporal trend at both the national level and for some provinces based on the survey data ($P < 0.05$) (Table 1). Based on the laboratory data, the Cochran-Armitage trend test suggested a temporal trend from 2007 to 2016 for Manitoba and Quebec ($P < 0.05$); with respect to the trend line for these provinces, prevalence increased (Figure 1 — right). The trend test for Ontario suggested a temporal trend from 2007 to 2016 ($P < 0.05$); the trend line showed a decrease in prevalence (Figure 1 — right).

The true prevalence for the laboratory data year 2015 was estimated to be 0.165% based on the calculation using apparent prevalence and sensitivity and specificity of the antigen test, which was very close to the apparent prevalence of 0.17% (17). The comparison of true prevalence to apparent prevalence was used with the aggregate prevalence for the years 2007 to 2016 for all dogs tested. The apparent prevalence for Manitoba was underestimated at 0.35% compared to the true prevalence of 0.37%. Ontario had similar apparent and true prevalences of 0.12% and 0.11%, respectively. True and apparent prevalences were the same for Quebec at 0.27%. The positive predictive value was estimated at 96.1% for all dogs tested for the laboratory diagnostic year of 2015, indicating that only 3.9% of the positive tests that year were false positives.

The choropleth map for survey data indicated that Alberta and Quebec had the highest aggregate smoothed prevalence from 1981 to 2010 (Figure 2). The choropleth map based on the laboratory data illustrated that Manitoba and Quebec had the highest aggregate smoothed prevalence from 2007 to 2016 for all dogs (Figure 3). Figure 3 also shows the
spatial distribution of submitted samples from across Canada: the southern parts of provinces, especially southern Ontario, were the origin of most samples. A spatial comparison of the 2 maps shows an increased prevalence in Manitoba and a decreased prevalence in Ontario (Figures 2 and 3).

Descriptive statistics for the apparent efficacy of preventive drugs are presented in Table 3. The AFe is interpreted here as the total amount of heartworm infections prevented by chemoprophylaxis aggregated for all years and was estimated to be 93.08% (95% CI: 92.85, 93.31). The AFe fluctuated between years, but the estimate for the year 1996 (AFe = 62%) is far below that of the other years, which range between AFe = 93% and AFe = 98%. The maximum AFe was attained in 2010 (Table 3).

**Discussion**

The prevalence of heartworm in Canada varied over time. However, results from surveys between 1977 and 2010 displayed a consistent decrease among all provinces. In contrast, the prevalence estimated from laboratory diagnostics conducted between 2007 and 2016 increased for Manitoba and Quebec (Figure 1 — right). It should be noted that the sample size has increased over time for both data sources, which may limit the potential for selection bias of clinics whose veterinarians consistently report cases. The increase in sample size over the years could also mean that more veterinary clinics are suggesting routine heartworm testing to their clients, or that there are more owners concerned about heartworm, leading to an increase in testing. The antigen test is also used for detection of antibody to *Borrelia burgdorferi* and other tick-borne infections. Thus, the increase in testing may also be due to increased awareness/testing for tick-borne infections. Testing occurred year-round; however, there was no indication of the reason behind the test. Most tests occurred from April to June; suggestive for routine heartworm testing, but the proportion of tests outside this period increased over 2007 to 2016.

There were major differences between the survey and laboratory datasets. The annual surveys were based on veterinarian-reported cases of heartworm in which the veterinarian acted as a “gold standard.” However, there can be differences of opinion or method among veterinarians and without a diagnostic test it is not possible to estimate the true prevalence. The prevalence reported from the survey data from 1977 to 2010 could have

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**Figure 3.** Choropleth map of aggregated smoothed heartworm prevalence from 2007 to 2016 using laboratory data for Canada for all dogs tested. The distribution of veterinary clinics with submitted samples is overlaid; the size of the point is weighted by the number of submissions.
Table 3. The estimated annual Attributable Fraction Exposed (AFE) with provinces aggregated to determine the percentage of cases prevented by chemophrophylaxis.

<table>
<thead>
<tr>
<th>Year</th>
<th>AFE</th>
<th>95% Confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>62.38%</td>
<td>59.30, 65.18</td>
</tr>
<tr>
<td>1997</td>
<td>92.63%</td>
<td>92.06, 93.14</td>
</tr>
<tr>
<td>1998</td>
<td>93.51%</td>
<td>92.93, 94.03</td>
</tr>
<tr>
<td>2000</td>
<td>93.90%</td>
<td>93.24, 94.48</td>
</tr>
<tr>
<td>2001</td>
<td>97.59%</td>
<td>97.27, 97.88</td>
</tr>
<tr>
<td>2002</td>
<td>96.07%</td>
<td>95.61, 96.48</td>
</tr>
<tr>
<td>2010</td>
<td>98.26%</td>
<td>98.08, 98.42</td>
</tr>
<tr>
<td>Total</td>
<td>93.08%</td>
<td>92.85, 93.31</td>
</tr>
</tbody>
</table>


been seriously over- or underestimated. An antigen test was used for laboratory data, and although the test was updated from 2007 to 2016, the technique remained consistent. Despite the difference in methodology, the comparison of results was similar nationally and for Ontario. However, the possible variance in reporting measures used in the survey data makes a fair comparison to the laboratory data across space and time difficult.

The focus of the analysis was on Ontario due to the large sample size for that province, with additional specific study of Quebec and Manitoba, the provinces with second and third highest number of tests. A significant decrease in temporal trends for survey prevalence from 1981 to the early 2000s was noted in both Manitoba and Quebec. However, the prevalence among laboratory tested dogs from 2007 to 2016 depicted a significant increasing temporal trend (Figure 1 — right). Due to the large sample size from Ontario, the prevalence pattern seen for Canada closely follows the observed Ontario prevalence; despite the significant temporal decrease for Ontario laboratory prevalence reports there was not a trend at the national level (Figure 1 — right).

The western provinces do not appear to have experienced changes in heartworm prevalence, except for Manitoba. The western United States that borders with the prairies in Canada have low heartworm prevalence compared to eastern states and this border relationship may contribute to the spatial distribution of heartworm among Canadian provinces (28). There was no information on travel history for laboratory data; however, the 2010 survey for western provinces stated most of the positive dogs never left the province (13). It is possible that recent changes in climate may have affected the mosquito populations of Manitoba, thus impacting the heartworm prevalence among dogs.

The positive trend in prevalence seen in Manitoba and Quebec could be due to a changing climate in these provinces providing more favorable conditions for heartworm development in mosquitoes. The province of Ontario, for example, has experienced longer heatwaves during the summer (12). If other provinces, such as Manitoba or Quebec are experiencing similar heatwaves, that could produce a more supportive environment for the mosquito lifecycle. In addition, these heat waves could produce the heat required for quicker maturation to the infective third-stage larvae. Both factors could affect the transmission of heartworm infection among dogs.

The laboratory study limitations include the small sample sizes for the Atlantic Provinces, Saskatchewan, and the Yukon. A small sample size can affect the prevalence estimates as it is based on only a few dogs. The data were aggregated over time for choropleth mapping, as heartworm is a rare infection and some years had limited sample sizes. The aggregation of data to ensure adequate sample sizes was a limitation because it examines heartworm prevalence on a larger temporal scale than what occurs in a year; the choropleth maps represent the study period prevalence and not an individual year.

The limitations of the macroscopic view of heartworm infection in Canada from this study should be addressed. A detailed map of Ontario that depicts where most cases were diagnosed would provide better insight as to where hot spots of heartworm infection exist. Determining the location of hot spots might provide veterinarians with a communication tool for advising their clients on the necessity of preventive treatments. Additionally, regional climate data should be examined for spatial and temporal increases in Dirofilaria-development-units from 2005 to 2016 (the number of days over 14°C) (5). There could be changes in the spatial distribution or seasonality of development units that affect the transmission of heartworm.

Dog ownership can be expensive. A socio-economic status that permits paying for tests and regular veterinary visits may contribute to selection bias. Diagnosis is possible only among dogs which frequent a veterinarian and are tested, thus the prevalence may be under-reported as not all domestic dogs frequent the veterinarian or undergo testing. The subset of dogs not tested could also not have prophylaxis and be at greater risk of heartworm infection, but their infections are also not being captured. In a 2011 United States survey of more than 50,000 households, 18.7% of dog owners reported not taking their dog to the veterinarian (29).

Compliance is a problem with prophylaxis, as some owners may not follow the instructions for dosing. However, information on prophylaxis compliance among dog owners is incomplete: it is only available for a few dogs and based on the assumption that owners correctly recall their compliance (2). The issue of compliance can lead to a misclassification bias, in which the protected group may include dogs that are not effectively protected. Furthermore, for oral products, gastrointestinal complications can lead to lower drug uptake by the patient and leave a dog vulnerable to infection (2). In Canada, the efficacy of prophylaxis among survey dogs from 1996 to 2010 has remained above 62% (Table 3). The low efficacy seen in 1996 appears to have been an anomaly, as efficacy remained high after that year (Table 3). There were no new prophylaxis drugs released that year and the survey did not mention an influx of imported rescue dogs. Several owners of dogs which tested positive while on prophylaxis had told their veterinarian that they had missed a dose, so it is likely the low efficacy seen was due to poor compliance.

This study shows that although previous reports of heartworm infection in Canada have indicated a decrease in cases from 1977 to 2010, in certain provinces such as Manitoba and
Quebec, heartworm prevalence was on the rise from 2007 to 2016 (Figure 1). Ontario, which has previously been a heartworm focus in Canada, displayed a decreasing temporal trend in prevalence from 2007 to 2016. Climate change may play a role in the epidemiological differences seen in heartworm infection across the country, although further investigation is required to separate this effect from the effect of preventive medication among dogs. The importance of chemoprophylaxis in preventing heartworm infection was illustrated, with an average of 93% of infections being prevented among dogs. This highlights the importance of regular veterinary visits and obtaining a preventive option for a dog that maximizes compliance.

Acknowledgments

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References


Introduction

Western Canadian dairy farmers have been using anthelmintic products for decades to control various endo- and ectoparasites. Since the introduction of broad-spectrum anthelmintic products to the cattle industry in the 1980s, there has been widespread use of anthelmintic “blanket treatments” as a protective measure against the detrimental production impacts of gastrointestinal nematode (GIN) burdens. The effects of GIN in dairy cattle are often subclinical, yet infection with GIN can significantly impair milk production (1,2). A recent study in Saskatchewan beef cattle showed that pastured beef cattle had a GIN prevalence of 79.5%, although the mean fecal egg counts were low [4.4 eggs per gram (EPG) of feces in the spring to 11.6 EPG in the fall] (3). A similar study in Saskatchewan cow-calf pairs also reported a low mean fecal egg count of just over 5.0 EPG and nearly 8.0 EPG in cows and calves, respectively (4). In that study, most producers were using anthelmintic products (mainly macrocyclic lactones) in the fall, and only treating the cows (4). Although beef and dairy cattle are not likely to share pastures, these studies show that the prevalence of GIN in Saskatchewan is widespread and warrants further study in the dairy industry.

Frequent treatment and underdosing with anthelmintics have been contributing factors to the increased prevalence of anthelmintic resistance in the United States and New Zealand (5,6). There are currently no anthelmintic resistance data available for the Canadian dairy cattle industry, but a recent study in Canadian beef herds observed a mean reduction in strongylid egg counts of only 69.3% for herds treated with macrocyclic lactone products (7). Another study in Ontario sheep flocks

Endoparasite control practices on Saskatchewan dairy farms

Haley Scott, Murray Jelinski, Chris Luby, Fabienne Uehlinger

Abstract — A questionnaire was administered to dairy producers in Saskatchewan in 2016 to determine basic pasture management practices, how producers use parasite control products, and attitudes towards the threat of endoparasites. All 161 dairy producers in Saskatchewan were invited to participate and the survey response rate was 39.8% (64/161). Most respondents (78.3%) were not concerned with endoparasites in their cattle or the threat of anthelmintic resistance. Yet 79.7% of producers reported using anthelmintics in all classes of cattle (lactating cows, dry cows, weaned heifers, and bred heifers). The most common reasons for using an anthelmintic product were as part of a routine management strategy and for the control of external parasites. The most common method to determine dosage was by visual estimation of the animal’s weight. Together, these factors may increase the risk for development of anthelmintic resistance.

Résumé — Pratiques de contrôle des endoparasites dans les fermes laitières de la Saskatchewan. Un questionnaire a été administré aux producteurs laitiers de la Saskatchewan en 2016 afin de déterminer les pratiques de gestion de base du pâturage, comment les producteurs utilisaient les produits de lutte contre les parasites et les attitudes envers la menace des endoparasites. Tous les 161 producteurs laitiers de la Saskatchewan ont été invités à participer et le taux de réponse au sondage a été de 39.8 % (64/161). La plupart des répondants (78,3 %) ne se préoccupaient pas des endoparasites chez leur bétail ni de la menace de la résistance aux anthelminthiques. Pourtant 79,7 % des producteurs ont signalé qu’ils utilisaient des anthelminthiques dans toutes les catégories de bétail (vaches en lactation, vaches taries, génisses sevrés et génisses accouplées). Les raisons les plus communes pour l’utilisation du produit anthelminthique était dans le cadre d’une stratégie de gestion routinière et pour limiter les parasites externes. La méthode la plus commune de déterminer la posologie était l’estimation visuelle du poids de l’animal. Ensemble, ces facteurs peuvent accroître le risque du développement de la résistance aux anthelminthiques.

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demonstrated that 97% of farms sampled had ivermectin resistance (8). As a result, the Canadian cattle industry should not ignore the increasing evidence of anthelmintic resistance globally, and more sustainable GIN control practices are warranted to slow the spread of resistance.

The variation in grazing management strategies for the control of GIN is extensive, the goal being to limit the exposure to infective stage larvae and interrupt the GIN life cycle. For example, Eysker et al (9) found that moving young cattle once per month after July until the end of the grazing season was sufficient to control gastrointestinal parasitic infections in the Netherlands. Larsson et al (10) found that moving first season grazers once mid-season and ensuring that they did not graze the same pasture in consecutive years were effective measures in maintaining GIN burdens at acceptable levels in Sweden without the use of anthelmintics. These results highlight the importance of pasture management in controlling GIN and suggest that GIN may be managed with limited anthelmintic use in some situations. These strategies also depend on factors including climate, type of pasture, season, and stocking density, and will vary between farms and regions.

With increasing anthelmintic resistance, stakeholders will eventually have to embrace alternative GIN management strategies. To improve recommendations for the industry, it is important to determine current endoparasite control practices used on western Canadian dairy farms. These practices will influence GIN prevalence and the rate of anthelmintic resistance development. Given the lack of information on GIN management practices in western Canadian dairy farms, the main aims of this study were to determine producers’ attitudes towards the potential threat of GIN, and to describe current GIN control practices used in maintaining GIN burdens at acceptable levels in Canada. These results highlight the importance of pasture management in controlling GIN and suggest that GIN may be managed with limited anthelmintic use in some situations. These strategies also depend on factors including climate, type of pasture, season, and stocking density, and will vary between farms and regions.

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Materials and methods

Study population

All 161 dairy producers in the prairie province of Saskatchewan (SK) were invited to participate in the questionnaire through the provincial milk marketing board (SaskMilk). The questionnaire was distributed in June 2016 via an online link, or by fax to those producers without Internet access. Subsequently, paper copies with postage-paid return envelopes were distributed in October 2016, making the questionnaire available to all producers in 2 formats. To maintain confidentiality of respondents, SaskMilk distributed the questionnaire to producers directly. The survey was closed in February 2017.

Questionnaire

The survey comprised 16 questions on pasture management, the uses of parasite control products, and producers’ attitudes towards endoparasites in their herds. To assist farmers in their responses, a handbook was supplied with the questionnaire that depicted all currently licensed endoparasite control products for use in dairy cattle in Canada. Questions about grazing management and specific use of parasite control products pertained to the previous (2015) grazing season. Where applicable, the questions distinguished different production groups (lactating cows, dry cows, weaned heifers (birth to breeding), and bred heifers (bred to calving]). Question types included a mixture of rating, ranking, and multiple-choice questions; some questions allowed participants to select more than one answer. A Likert Scale with 5 points was used for 2 questions, where 1 = not concerned, 3 = somewhat concerned, and 5 = very concerned. Similarly, one question asked producers to rank the importance of various characteristics of an endoparasite control product on a scale of 1 to 5, where 1 = not important, 3 = somewhat important, and 5 = very important. For the purpose of this questionnaire, producers were asked to estimate the stocking density on their pastures, measured in animals per acre, or the number of head of cattle on an acre of land. The questionnaire was pre-tested with 2 bovine veterinarians and 2 dairy producers before being made available to all registered producers. This study was approved by the University of Saskatchewan’s Behavioural Ethics Board (BEH-20160042).

Data analysis

Questionnaire responses were entered into a commercial spreadsheet program (Excel 2013; Microsoft, Redmond, Washington, USA). A commercial software package (Stata 14.2; College Station, Texas, USA) was used to examine the coded questionnaire responses. Descriptive summary statistics were performed for each of the reported questionnaire responses and reported as frequencies or means [± standard deviation (SD)].

Results

Survey response rate and herd demographics

The survey response rate was 39.8% (64/161) and surveys were received over a period of 8 mo (July 2016 to February 2017). Of the respondents, 42.2% (27/64) responded via e-mail/fax and 57.8% (37/64) returned paper copies of the questionnaire via mail. Some producers opted not to answer certain questions; denominators reflect the number of producers who answered that question. The mean herd size was 151 lactating cows (SD: 120), 27 dry cows (SD: 16), 67 weaned heifers (SD: 49), and 52 bred heifers (SD: 40).

Producers’ level of concern with endoparasites

When asked about how concerned dairy producers were with endoparasites in their cattle on a scale of 1 to 5, where 1 = not concerned and 5 = very concerned, most respondents (78.3%, 47/60) were not concerned or only somewhat concerned (i.e., reported a level of concern of 3 or lower). Only 16.7% (10/60) and 5.0% (3/60) of responding producers were concerned or very concerned, respectively. When asked about how concerned they were with anthelmintic resistance on a scale of 1 to 5, 72.4% (42/58) of producers responded that they were not or only somewhat concerned (i.e., reported a level of concern of 3 or lower), while 15.5% (9/58) and 12.1% (7/58) said they were concerned or very concerned, respectively.

Only 11.7% (7/60) of producers had any of their cattle tested for endoparasites in the 3y before the survey, while 81.7% (49/60) had not done any testing and 6.7% (4/60) of producers were unsure about whether any testing had been conducted. Producers who reported testing their cattle for endoparasites were
Table 1. Proportion of dairy herds that had access to pasture, and producer-assessed stocking density on pasture and pasture management, by dairy production group on Saskatchewan dairy farms (n = 64).

<table>
<thead>
<tr>
<th>Stocking density of those herds with pasture access</th>
<th>Milking cows</th>
<th>Dry cows</th>
<th>Weaned heifers</th>
<th>Bred heifers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1+ animals per acre</td>
<td>66.7% (6/9)</td>
<td>25.9% (7/27)</td>
<td>26.3% (5/19)</td>
<td>23.5% (8/34)</td>
</tr>
<tr>
<td>0.5 animals per acre</td>
<td>22.2% (2/9)</td>
<td>33.3% (9/27)</td>
<td>26.3% (5/19)</td>
<td>26.5% (9/34)</td>
</tr>
<tr>
<td>&lt; 0.5 animals per acre</td>
<td>11.1% (1/9)</td>
<td>40.7% (11/27)</td>
<td>47.4% (9/19)</td>
<td>50.0% (17/34)</td>
</tr>
<tr>
<td>Pasture rotations of those herds with pasture access*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No movement</td>
<td>88.9% (8/9)</td>
<td>74.1% (20/27)</td>
<td>63.2% (12/19)</td>
<td>64.7% (22/34)</td>
</tr>
<tr>
<td>1+ rotation</td>
<td>11.1% (1/9)</td>
<td>25.9% (7/27)</td>
<td>36.8% (7/19)</td>
<td>35.3% (12/34)</td>
</tr>
</tbody>
</table>

* One producer did not indicate stocking density for weaned heifers or whether or not weaned heifers were moved between pastures.

Table 2. Summary of endoparasite control product usage, by production type of cattle, for the 2015 grazing season on Saskatchewan dairy farms (n = 47).

<table>
<thead>
<tr>
<th>Production type</th>
<th>Milking cows</th>
<th>Dry cows</th>
<th>Weaned heifers</th>
<th>Bred heifers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of farms that used an endoparasite control product in 2015 (n = 47):</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>85.1% (40/47)</td>
<td>78.7% (37/47)</td>
<td>76.6% (36/47)</td>
<td>74.5% (35/47)</td>
<td></td>
</tr>
<tr>
<td>Of those farms that used an endoparasite control product, how many used a topical pour-on product?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>97.5% (39/40)</td>
<td>97.3% (36/37)</td>
<td>94.4% (34/36)</td>
<td>100% (35/35)</td>
<td></td>
</tr>
<tr>
<td>Of those farms that used an endoparasite control product, which drugs were used?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ivermectin</td>
<td>7.5% (3/40)</td>
<td>18.9% (7/37)</td>
<td>63.9% (23/36)</td>
<td>48.6% (17/35)</td>
</tr>
<tr>
<td>Eprinomectin</td>
<td>52.5% (21/40)</td>
<td>40.5% (15/37)</td>
<td>13.9% (5/36)</td>
<td>20.0% (7/35)</td>
</tr>
<tr>
<td>Moxidectin</td>
<td>35.0% (14/40)</td>
<td>35.1% (13/37)</td>
<td>16.7% (6/36)</td>
<td>25.7% (9/35)</td>
</tr>
<tr>
<td>Doramectin</td>
<td>2.5% (1/40)</td>
<td>2.7% (1/37)</td>
<td>2.8% (1/36)</td>
<td>2.9% (1/35)</td>
</tr>
<tr>
<td>Fenbendazole</td>
<td>2.5% (1/40)</td>
<td>2.7% (1/37)</td>
<td>2.8% (1/36)</td>
<td>2.9% (1/35)</td>
</tr>
</tbody>
</table>

Housing and grazing management

The number of producers who reported giving their dairy cattle access to pasture and producer-assessed pasture stocking densities are reported in Table 1. Milking cows were the least frequent, while bred heifers were most frequent to have access to pasture. Of those herds with access to pasture, most in each of the 4 production groups were set stocked (no change in animals/acre over the grazing season) and not rotated between pastures (Table 1).

Producers were asked to report whether grazed heifers (weaned or bred) were “always,” “sometimes,” or “never” co-grazed with adult cows. Of the 53 producers who gave heifers access to pasture and who answered the question about co-grazing, 28.3% (15/53) always or sometimes co-grazed heifers with adult cows while 24.5% (13/53) said they never co-grazed. The remaining 47.2% (25/53) indicated that heifers had no access to pasture.

Use of parasite control products

Most producers (79.7%; 47/59) reported using an endoparasite control product in 2015. Of those who used an endoparasite control product, 72.9% (43/59) treated the entire herd (or entire production group) compared with 6.8% (4/59) who reported treating animals on a case-by-case basis. The remaining 20.3% (12/59) did not use endoparasite control products. The use of endoparasite control products based on the different dairy production stages is summarized in Table 2. Macro cyclic lactone products (including ivermectin, eprinomectin, moxidectin, and doramectin) were used by most producers in all 4 production types: 97.5% (39/40) for milking cows, 97.3% (36/37) for dry cows, 97.2% (35/36) for weaned heifers, and 97.1% (34/35) for bred heifers. Only 1 producer reported using fenbendazole in all production groups. A topical, pour-on product was used in 94.0% to 100.0% of all production types.

The most common reason producers dewormed their cattle because it was part of a routine management plan (39.7%, 25/63), followed by a desire to control external parasites (27.0%, 17/63). Only 12.7% (8/63) of producers said they used an endoparasite control product (36.6%, 26/40), followed by a desire to control external parasites (27.0%, 21/71; producers were permitted to select more than one option for this question). Producers were also asked to rate the importance of price, the labelled or perceived efficacy of a product (36.6%, 26/71), followed by dosing of all animals based on the estimated weight of the heaviest animal in the group (21.1%, 15/71; producers were permitted to select more than one option for this question). Producers were also asked to rate the importance of price, the labelled or perceived efficacy of a product, ease of application, and usage based on a veterinarian’s
were not very concerned with endoparasites, nor with the practices on Saskatchewan dairy farms. In general, producers of the product (Figure 1).

Figure 1. Importance of price, labeled or perceived efficacy, ease of application, and veterinary recommendation on producers’ selection of an endoparasite control product. Producers were asked to rate the importance of each feature on a scale of 1 to 5, where 1 = not important and 5 = very important.

Discussion

This is the first evaluation of endoparasite control management practices on Saskatchewan dairy farms. In general, producers were not very concerned with endoparasites, nor with the possibility of anthelmintic resistance. However, most producers reported using anthelmintics in all of their animals, including weaned and bred heifers. This result is similar to that of the National Animal Health Monitoring System report by the US Department of Agriculture in 2014, where 70.8% of surveyed producers with a herd size of 100 to 499 head used a deworming product for their heifers (11). A possible justification for this contradiction between the level of concern and the use of anthelmintics may be explained by why producers use anthelmintics. Many producers stated that their most important reasons for the use of these products were because it was a conventional/routine practice and for the control of external parasites (i.e., lice). Conversely, comparatively fewer producers reported that the most important reason for treating their herd with anthelmintics was to manage endoparasites. This shows that producers treat their cattle with anthelmintics, but they are not doing it specifically to manage GIN populations.

Interestingly, many respondents who reported giving their heifers access to pasture during the summer months indicated they used light stocking densities and few producers moved heifers between 2 or more pastures. While light stocking densities would serve to reduce the exposure of cattle to GIN, the limited use of pasture rotation could compromise GIN control (12). However, further research would be needed in Saskatchewan to clarify the different grazing systems used and their role as potential risk factors for GIN burden in Saskatchewan dairy cattle. Most producers in Saskatchewan reported that their grazed heifers were not co-grazed with adult cattle. Although adult cattle are a prominent GIN reservoir and contaminate pastures in the spring, they also help dilute the larval population as the grazing season progresses by ingesting large numbers of larvae (12,13). It may then be beneficial to avoid co-grazing heifers and cows early in the grazing season to minimize the heifers’ exposure to larvae. Nevertheless, there needs to be a sufficient level of exposure to GIN in young cattle in order to build an adequate immunity against GIN in the following grazing season. Eysker et al (9) argue that low exposure in the first grazing season may have detrimental impacts on animals in their second grazing season due to a lack of immunity. Therefore, controlled co-grazing of young heifers with mature cows may be desirable at some stage during the first grazing season.

For those producers who indicated that they used anthelmintic products, the most common product used was ivermectin for heifers. Producers also reported that ease of application was important in choosing a parasite control product, which was reflected by the preferred use of topical/pour-on products. In contrast, the most common product used for milking and dry cows was eprinomectin, although moxidectin was also used frequently. Eprinomectin and moxidectin are presumably the most popular for cows since these products have a zero milk withholding period, and ivermectin is likely more standard for heifers since it is less expensive (5). To compare, a recent GIN prevalence study in 14 Saskatchewan cow-calf beef herds noted that all producers surveyed dewormed their herds with ivermectin products (4). In that study, all but 3 producers dewormed their cattle in the fall, which is better suited for the treatment of ectoparasites (4). Eprinomectin, moxidectin, and ivermectin are all macrocyclic lactones, and it has been shown that the exclusive use of 1 class of anthelmintics may propel the development of anthelmintic resistance; cases of resistance to ivermectin are widely documented (14–16).

In the current survey, most respondents reported only deworming their herds once per year. A study in Sweden reported that 76% of producers who used anthelmintics used topical/pour-on macrocyclic lactone products, and dewormed only once or twice per year (14). Despite this, the frequency of anthelmintic resistance to macrocyclic lactones was considered high under field conditions in that study. Since similar deworming practices were reported in the current questionnaire, the risk of anthelmintic resistance development must be considered.

A risk factor for the development of anthelmintic resistance in cattle herds is underdosing of the animal, thereby facilitating the development and proliferation of resistant parasites (17). In the producer questionnaire, the most popular method of determining the dosage when applying endoparasite control products was estimating the animal’s weight visually. This practice could promote resistance development as it is an unreliable method for weight determination and underestimation is common (18). Given the increased labor through using a weight tape or the need for specialized equipment (i.e., weigh scale), it is not surprising that visual estimation was the most frequent way of determining an animal’s weight. That practice also mirrors that of dairy producers in Sweden, where the frequency of anthelmintic resistance was considered high (14). Comparatively, the development of anthelmintic resistance in Saskatchewan dairy cattle is a conceivable threat, although future studies are needed to evaluate the current state of anthelmintic resistance in these cattle.
Nearly 3 quarters of producers reported that they treated their entire herd or an entire group of cattle at once, as opposed to treating animals on a case-by-case basis. Using targeted selective treatment, where only individual animals are treated when needed, as opposed to treating an entire group of animals reduces the amount of anthelmintics used (19). It also serves to keep a proportion of the nematode population in refugia (susceptible to anthelmintics) and therefore slows the spread of resistant nematodes (20). In the sheep industry, several studies showed no difference in weight gain between treated and untreated lambs when the heaviest animals were left untreated (21,22). In first-season grazing cattle, a retrospective study observed that untreated animals had higher anti-*Ostertagia* serum antibody levels and achieved poorer performance than selectively treated cattle (23). One study in Sweden found that using a targeted selective treatment strategy improved weight gains in first season grazing calves compared to an untreated control group, but gains were not as high as those for calves all treated together at regular intervals (19). The use of anthelmintics in the targeted selective treatment group, however, was reduced by 92% compared to the group dewormed as a herd at regular intervals (19). If targeted selective treatments were implemented in cattle (i.e., leaving the heaviest animals in the herd untreated), it may be possible to mitigate the production impacts of GIN while saving the producer money, and preserving anthelmintic efficacy by reducing the amount of anthelmintics used (19,23,24).

As questionnaires are valuable tools for gathering information from producers, there are potential sources of bias. Response bias was possible in this study; the response rate was only 40%, and it was possible that producers who responded to the questionnaire were more interested in parasites because of previous herd health or production issues (perceived or clinically diagnosed) due to parasites. A recall bias was likely because producers were asked about pasture management and deworming schedules in 2015, the year before the questionnaire was administered. The questionnaire also consisted of mainly close-ended questions, and the available answer options may not have reflected all producers’ preferred answers. Nevertheless, the questionnaire provided valuable insight into Saskatchewan producers’ attitudes towards the use of anthelmintics, and the current methods used to control endoparasites in Saskatchewan dairy herds.

In conclusion, most producers reported that they are generally not concerned with the impacts of endoparasites or the threat of anthelmintic resistance. Many producers are, however, applying anthelmintic products and using practices that inevitably have an impact on the GIN populations and the risk of developing anthelmintic resistance in their herds. These included: almost exclusive use of macrocyclic lactones, routine blanket treatment of an entire herd, and visual estimation of body weight to determine product dose. Future research should directly quantify the production impacts of subclinical GIN infections on breeding-age dairy heifers and to objectively determine the efficacy of current anthelmintics in dairy cattle in Saskatchewan. This is likely one of the most important aspects needed to determine whether GIN management changes are necessary and, if so, to heighten producers’ interest in more sustainable, alternative management practices.

Acknowledgments

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Efficiency of ultrasound-guided aspiration of medial retropharyngeal lymph node in dogs
Changseok Kim, Michelle L. Oblak, Stephanie Nykamp

Abstract — The purpose of this retrospective cross-sectional study was to assess the diagnostic yield of ultrasound-guided aspiration of the medial retropharyngeal lymph node (MRPLN) and to report factors on computed tomography (CT) evaluation that are predictive of obtaining a diagnostic sample. A secondary objective was to report CT size reference ranges for cytologically confirmed normal MRPLNs in dogs. Medical records and CT images of 69 dogs were retrospectively reviewed. The diagnostic yield of ultrasound-guided aspiration on MRPLNs was 47.5%. Six lymph nodes were positive for metastasis with various cancers. Only rostral height was predictive of the diagnostic yield. The Pearson correlation coefficient and Spearman’s Rho tests suggested that the age of the dog has significant negative linear correlation with the size of MRPLNs while the weight has positive correlation. Overall, ultrasound-guided aspiration of MRPLN has low diagnostic yield in normal size lymph nodes. Prior case selection based on CT evaluation may increase the probability of diagnostic samples.

Introduction

Lymph node staging and localization of pathological lymph nodes in cancers of the head and neck are important to direct either (neo)adjuvant or surgical therapy and are a major factor in determining prognosis (1,2). Lymphatic drainage of the head involves multiple lymph centers; the main sites include the parotid, mandibular, and medial retropharyngeal lymph nodes (3,4). In a recent study of dogs with head and neck cancers undergoing lymphadenectomy, 45% of dogs with malignancies of the head had metastasis to regional lymph nodes, including the mandibular lymph nodes and medial retropharyngeal lymph nodes (MRPLNs) (5). This study demonstrated a high prevalence of lymphatic metastasis with malignancies of the head and emphasized the importance of staging prior to treatment.

As MRPLNs are not palpable unless there are significant increases in size or changes in consistency (6), ultrasound-guided aspiration is frequently used in veterinary medicine for sample collection from the MRPLN. In human studies evaluating the accuracy of ultrasound-guided aspiration and cytology of neck nodes, the accuracy was better with its sensitivity and specificity than other modalities including computed tomography (CT) and magnetic resonance imaging (7–9). Ultrasound-guided aspiration of neck nodes also was reported to have a high diagnostic yield up to 97.8%; however, the diagnostic yield of ultrasound-guided aspiration has not been studied in veterinary medicine.
especially for the MRPLN. While the normal appearance and size of the MRPLN in dogs have been reported for ultrasonography (10), the diagnostic yield of ultrasound-guided aspiration of the MRPLN and the predictors of obtaining diagnostic samples of ultrasound-guided aspiration have not been evaluated in dogs.

Computed tomography (CT) is the preferred imaging modality for evaluation of head and neck cancers for surgical or radiation planning and may also be useful for evaluation of regional lymph nodes (11). The CT parameters of normal MRPLN in dogs have been described in a previous study (12); however, the diagnosis of the lymph node was not confirmed by cytology or histology. The information from CT evaluation prior to ultrasound-guided aspiration might provide useful information on the probability of acquiring diagnostic samples via ultrasound-guided aspiration and help pet owners and clinicians to decide whether to pursue ultrasound-guided aspiration of the MRPLNs.

The purpose of this study was to assess the diagnostic yield of ultrasound-guided aspiration of the MRPLN and to report factors on CT evaluation predictive of whether a diagnostic sample would be obtained. A secondary objective was to report CT size reference ranges for cytologically confirmed normal MRPLNs in dogs. We hypothesize that the characteristics of MRPLNs on CT image are predictive of obtaining diagnostic samples. We also propose that age and weight have impacts on the sizes of cytologically normal MRPLNs.

**Materials and methods**

The study was a retrospective cross-sectional design performed at a single institute. Medical records of the Ontario Veterinary College Health Sciences Centre Small Animal Clinic between September 2011 and March 2017 were reviewed for dogs with ultrasound-guided aspiration and cytology of the MRPLN. Dogs included if the MRPLN had been aspirated by ultrasound guidance following CT evaluation of the head and neck, and cytology result of the MRPLN was available. Computed tomography data for the MRPLN characteristics were evaluated and parameters recorded by a Board-certified veterinary radiologist who was unaware of patient medical history. All images were evaluated with 1 image analysis program (Horos 2.2.0; GNU Lesser General Public License at Horosproject.org) run on a computer workstation (Apple iMac 27 inch; Apple, Cupertino, California, USA). Window width and level were standardized to the image algorithm (W: 350/L: 40 for soft tissue).

The CT images were evaluated as previously described (13). The width and height of the rostral, middle, and caudal aspects of each lymph node were measured in transverse CT images. Length of lymph nodes in CT images was determined using the CT slice thickness (calculated CT lymph node length) and was measured in sagittally reformatted CT images with an electronic caliper tool by use of imaging software (measured CT lymph node length). Attenuation (Hounsfield units) was determined by obtaining the mean attenuation value for all voxels within the region of the largest portion of MRPLNs. Ratios of the rostral, middle, and caudal lymph node widths to the lymph node length (i.e., short-axis-to-long-axis length ratios) were determined. Each lymph node was subjectively evaluated to determine parenchymal heterogeneity; ratings of none, mild, moderate, or severe were assigned. Lymph node hilus was defined as a focal hypo-attenuating region in the middle to rostral aspect of the lymph node and categorized as present or absent. Computed tomography images were evaluated to determine whether lymph node margins were smooth or irregular. Amount of fat was rated as small if there was insufficient fat to separate the margins of adjacent structures, moderate if fat was observed along the dorsolateral to ventromedial aspects of a lymph node, and large if fat completely encircled a lymph node.

Data collected from medical records included breed, age, and gender, tumor type and location, as well as cytological diagnosis of the MRPLN. All decisions for group assignment were made by a Board-certified veterinary surgical oncologist (M.O.) solely based on final diagnoses on cytology reports. Cytological diagnoses of MRPLN were grouped as non-neoplastic (benign) or neoplastic (malignant). Diagnoses for non-neoplastic disease were categorized as normal lymphoid tissue, reactive lymphoid hyperplasia, or inflammation (purulent, eosinophilic, granulomatous, or mixed, with or without reactive hyperplasia or necrosis). Diagnoses for neoplastic disease was categorized as carcinoma, sarcoma, melanoma, and others. For patients with head and neck cancers, the location of the primary neoplasm was recorded and classified as left, right, or middle. The location was further specified as one of the following groups: oral, nasal, thyroid, and others. The histological diagnosis and mitotic index of the primary tumor were recorded, when available.

**Statistics**

Statistical analyses were performed using commercially available software (SAS version 9.4; SAS Institute, Cary, North Carolina, USA) with the assistance of a statistician. Direct logistic regression was performed to assess the impact of the investigated variables on the likelihood of obtaining diagnostic samples of MRPLNs by ultrasound-guided aspiration. The model contained 24 independent variables including gender, age, weight, diagnosis of primary tumor, location and side of primary tumor, mitotic index, and CT measurements of the MRPLN (rostral height/width, middle height/width, caudal height/width, length measured by CT thickness slides and caliper, attenuation, heterogeneity, presence of hilus, margin, amount of surrounding fat, volume, ratios of short to long axis in rostral, middle, and caudal MRPLNs). Correlation between age/weight and CT measurements of cytologically normal MRPLNs was investigated using Pearson correlation coefficient and Spearman’s *Rho* tests. Significance was set at *P* < 0.05; however, different correlation coefficient (*r*) values were applied to determine the statistical significance depending on the sample sizes in those analyses (14).

**Results**

Sixty-nine dogs met the inclusion criteria and consisted of 25 breeds including mixed breed dogs (*n* = 17), golden retriever (*n* = 12), Labrador retriever (*n* = 7), Jack Russell terrier (*n* = 4), pug (*n* = 3), West Highland white terrier (*n* = 3), beagle (*n* = 2),
bearded collie (n = 2), Pomeranian (n = 2), toy poodle (n = 2), and 1 each of dogue de Bordeaux, Great Dane, Havanese, Nova Scotia duck tolling retriever, Rottweiler, standard schnauzer, Australian shepherd, Airedale terrier, shih tzu, Siberian husky, Brittany spaniel, English springer spaniel, fox terrier, Norfolk terrier, and vizsla. The median body weight was 27 kg (range: 3.9 to 54 kg), and the median age was 10.5 y (range: 1 to 15 y).

There was 1 sexually intact female, 31 spayed females, 2 intact males, and 35 castrated males. Primary tumors or lesions were diagnosed by cytology or histology as carcinoma (n = 31), sarcoma (n = 19), melanoma (n = 9), others (n = 10) including inflammation (n = 4), mast cell tumor (n = 2), thymoglossal duct cyst (n = 1), myoepithelioma (n = 1), undifferentiated neoplasia (n = 1) and unknown (n = 1). The locations of primary lesions were categorized into nasal cavity (n = 25), oral cavity (n = 21), thyroid gland (n = 8), and others (n = 13 including larynx (n = 3), lip (n = 2), nasal planum (n = 2), forehead (n = 1), right hindlimb (n = 1), spine (n = 1), thymoglossal duct (n = 1), ear (n = 1), and salivary gland (n = 1) as well as left (n = 34), right (n = 23), and midline (n = 10). Two dogs had generalized lymphadenopathy without primary lesions; 1 dog was later diagnosed with lymphoma via lymph node cytology. The other dog was diagnosed with lymphadenitis with histopathology of the lymph node; however, the primary cause of this finding was not identified. A total of 28 primary tumors had information on mitotic index. The median mitotic index of the primary tumors was 10 (range: 0 to 161/10 hpf).

All ultrasound-guided aspiration procedures were performed under general anesthesia. All included dogs underwent aspiration with guidance of an ultrasound system (Aplio 300; Toshiba Medical Systems, Tokyo, Japan or IU22, Philips Ultrasound, Bothell, Washington, USA) using a 22-gauge 1.5-inch needle. During the ultrasound-guided aspiration procedure, the needle was passed through the skin and subcutaneous tissue and advanced into the MRPLN under ultrasound guidance. The needle was moved to-and-fro in a fanning fashion inside the lymph node. In some cases, a syringe (6 mL) was attached but no physical aspiration was applied. In other cases, based on the performers’ preferences, negative pressure was applied with the syringe 5 to 7 times. After multiple aspirations, negative pressure was released and the needle was removed. Using air, the specimen was pushed out from the needle sheath onto a glass slide (15). All cytological evaluation of samples was performed and diagnosed by Board-certified veterinary clinical pathologists.

Computed tomography was conducted with either a CT scanner (Lightspeed-4 slice helical scanner; GE Medical Systems, Milwaukee, Wisconsin, USA) with slice thickness of 2.5 mm, collimator pitch of 0.8, matrix of 512 × 512, peak kilovoltage of 120 kVp, 0.8 s rotation speed and amperage of 140 to 200 mA or another CT scanner (GE Brightspeed-16 slice helical scanner; GE Medical Systems) with slice thickness of 0.625 mm, collimator pitch of 1, matrix of 512 × 512, peak kilovoltage of 120 kVp, 0.8s rotation speed and amperage of 140 to 200 mA. A total of 120 MRPLNs (left: n = 62, right: n = 58) were aspirated with ultrasound guidance under general anesthesia during the study. The procedures were performed by 5 Board-certified veterinary radiologists and 6 radiology residents. All samples were reviewed by Board-certified veterinary pathologists at the University of Guelph Animal Health Laboratory. The aspirated samples were classified as diagnostic in 57 MRPLNs (47.5%) and non-diagnostic in 63 MRPLNs (52.5%). Of these 57 diagnostic samples, 51 (89.5%) were benign and the remaining 6 (10.5%) had evidences of metastasis. Diagnostic samples were obtained in 29 of 62 left MRPLNs (46.7%) and 28 of 58 right MRPLNs (48.3%). The benign MRPLNs cytology consisted of normal (n = 37), reactive (n = 13), and inflammatory (n = 1) while metastatic MRPLNs contained melanoma (n = 2), sarcoma (n = 2), carcinoma (n = 1), and undifferentiated neoplasia (n = 1). Metastasis rates among diagnostic samples of MRPLNs were 20% melanoma, 11.7% sarcoma, and 5% carcinoma. The details of metastatic lymph nodes and the associated primary tumors are summarized in Table 1.

When logistic regression was performed, only 1 of the independent variables (rostral height) made a statistically significant contribution to the overall diagnostic yield with an odds ratio (OR) of 1.116 [95% confidence interval (CI): 1.031 to 1.216]. This indicated that the estimated odds of obtaining diagnostic sample increase multiplicatively by 1.116 for every 1 mm increase in the rostral height. Separate logistic regressions were performed with left and right sides of MRPLNs. The rostral height was statistically significant in the right side with an OR of 1.232 [95% CI: 1.076 to 1.453] while no variables had a significant impact on the result in the left side.

A total of 37 cytologically normal lymph nodes (left n = 19, right n = 18) were included in descriptive analysis (Table 2).
Pearson correlation coefficient and Spearman’s Rho tests were used to investigate the linear correlations between age/weight and CT parameters of the cytologically normal MRPLNs. In order to compensate for the limited number of the MRPLNs, different correlation coefficient values of 0.5, 0.6, and 0.7 were used in the analysis to determine statistical significance for both, left and right sides of MRPLNs, respectively (14). The analysis demonstrated that age had statistically significant negative linear correlations with middle height and width in both sides and left side of MRPLNs. The weight had significant positive linear correlations with volume and caudal width and length (by thickness and caliper) in both sides, however, with length (by thickness) alone in left side and with volume in right side. The details of this analysis are summarized in Table 3.

### Discussion

The overall diagnostic yield of ultrasound-guided aspiration of MRPLNs herein was low and only rostral height was positively correlated with predictability of obtaining diagnostic samples, however, the benefit of using this parameter might not be significant in a clinical setting given the low ORs. In the analysis of the normal MRPLNs, the overall measurement was similar to the results in previous studies and age/weight were correlated with the sizes of MRPLNs.

The diagnostic yield of ultrasound-guided aspiration of MRPLNs in the current study was lower (47.5%) than reported in human medicine (7). This difference could be explained by several factors. In the human study, the lymph nodes were aspirated only when metastasis was suspected in the target lymph nodes (measured > 3 to 4 mm in the smallest diameter) (7), whereas ultrasound-guided aspiration was attempted regardless of the size of lymph nodes in the current study. Also, many veterinarians with different levels of experience performed the procedure in this study, and half of the performers were residents with < 3 y of experience with the ultrasound-guided aspiration procedure. Even though the success rate of each performer did not appear to be associated with level of experience (data not shown), objective comparison was not possible as each performer had different numbers of attempts on various patients with diverse conditions of MRPLNs. It is also important to note that only MRPLNs were included in this study, while the previous study included various lymph nodes. To the authors’ knowledge, this is the first study reporting the diagnostic yield of ultrasound-guided aspiration including only MRPLNs. Thus, it is possible that different locations of lymph nodes might influence diagnostic yields, especially when the lymph node can be palpated and stabilized prior to aspiration. Lastly, ultrasound-guided aspiration procedures in comparative studies were performed in humans, thus, the anatomic differences between species might have to be taken into consideration.

In the current study, rostral height was positively associated with an increasing chance of obtaining diagnostic samples. It is unclear as to why only this parameter affected the diagnostic yield while others did not. Given that cranial and middle heights of normal MRPLNs were larger than caudal height in general (Table 3), it was supposed that the rostral aspect of MRPLNs might have been sampled more frequently than other aspects of MRPLNs as it might have been easier to target the cranial aspect for the ultrasound-guided aspiration performers. However, it is possible that other variables did not reach statistical significance simply due to the low statistical power from the low numbers of MRPLNs in this study.

Computed tomography measurements of MRPLNs in normal dogs were already reported in a previous study (12); however, the status of the included lymph nodes was not confirmed by either cytology or histology in that study. Furthermore, the measurements of MRPLNs in that study did not address irregular shapes of the nodes. A later study by Nemanic and Nelson (13) dealt with this issue by measuring the different parts of MRPLNs in cats. The current study applied the same CT parameters as Nemanic and Nelson (13) in measuring MRPLNs on CT images in order to specify the measurements in different parts of normal MRPLNs in dogs. Overall, the measurements were similar to a previous study despite differences in the patient population (10). The measurement of length and attenuation had the widest ranges and highest standard deviations among all parameters. As the length had positive linear correlation with weight in Pearson’s correlation coefficients, it might be that heavier dogs may have MRPLNs with longer lengths. The contributing factors to the variance of attenuation was not identified in this study, but the differences in the regions of MRPLNs included for the attenuation measurement between dogs might have contributed to the variance. Previous studies correlated the heterogeneity and hypo-attenuating hilus with presence of metastasis (16–18). These previous findings were supported in our study with low prevalence of heterogeneity (18.9%) and low prevalence of hilus absence (35.1%) in cytologically normal MRPLNs. However, the heterogeneity and absence of hilus found in cytologically normal MRPLNs, despite the low prevalence, suggest that these parameters cannot be used as

### Table 3. Pearson correlation coefficients (both sides, N = 37).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Analysis</th>
<th>Rostral</th>
<th>Caudal</th>
<th>Middle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>height</td>
<td>width</td>
<td>height</td>
</tr>
<tr>
<td>Age</td>
<td>$r$</td>
<td>-0.337</td>
<td>-0.407</td>
<td>-0.623</td>
</tr>
<tr>
<td>P-value</td>
<td></td>
<td>0.041</td>
<td>&lt; 0.0001*</td>
<td>0.001*</td>
</tr>
<tr>
<td>Weight</td>
<td>$r$</td>
<td>0.207</td>
<td>0.409</td>
<td>0.421</td>
</tr>
<tr>
<td>P-value</td>
<td></td>
<td>0.218</td>
<td>0.012</td>
<td>0.009</td>
</tr>
</tbody>
</table>

Criteria of statistical significance: $|r| > 0.5, P < 0.05$.

* Indicates statistical significance.

$r$ = Correlation coefficient.
sole indicators when predicting normal status of MRPLNs on CT images. The predictability of metastatic status using these parameters was not investigated as the number of metastatic nodes was not sufficient for analysis.

In the present study, only 5 out of 61 dogs (8.2%) with cancer were found to have metastasis and only 6 out of 120 lymph nodes were diagnosed with metastatic disease in MRPLNs. This metastasis rate is much lower than what was reported (35%) in a study by Skinner et al (5). This discrepancy can be explained by several factors. The present study investigated the metastasis status via ultrasound-guided aspiration and a half of the samples were non-diagnostic. In contrast, all MRPLNs from the studied dogs were histologically evaluated in the previous study. Therefore, the low diagnostic yield of ultrasound-guided aspiration might have led to falsely lower the metastatic rate. Also, the low metastatic rate may be attributed to the different compositions of tumor types between both studies. In the present study, the predominant tumor type was carcinoma (50%), whereas malignant oral melanoma composed most (41%) of the tumor populations in the previous study. Considering the high metastatic rate of malignant oral melanoma, it is possible that the innate bias in the studied groups might have contributed to these different metastatic rates between the 2 studies.

A previous study by Burns et al (10) demonstrated a strong correlation between age/weight and sizes of MRPLNs in healthy dogs when measured on ultrasound. In that study, the MRPLN increased in size with increased body weight and decreased in size with increased age. As in the previous study results, in our study age had a negative linear correlation with the size of MRPLNs, whereas weight had a positive linear correlation with the size, although the strength of relationships was not as strong. Even though only limited numbers of parameters (middle height/width, caudal width, and lengths) met the criteria in Pearson’s correlation coefficient and Spearman’s Rho tests, many parameters approached statistical significance. Given the trends shown in the data and the small number of normal MRPLNs included in the study, correlations between age/weight and the CT parameters might not have been discovered due to the low statistical power of this study. However, the differences between MRPLN sizes relative to age and body weight are not likely to be clinically important due to the small range of sizes observed, measurement error, and various possible combinations of age and body weight.

The present study had several limitations because of its retrospective nature. The number of MRPLNs included in this study was limited considering the high number of investigated variables. Therefore, the low number of MRPLNs decreased the probability of replicating significant results in larger studies. A second limitation was that many veterinarians and pathologists were involved in the ultrasound-guided aspiration procedure and interpretation of cytology and that the cytology samples were not re-evaluated by a single pathologist for this study. Also, the cytological diagnoses of MRPLNs were not confirmed by histology. Previous studies demonstrated low accuracy of cytology evaluation compared to histology (19,20). Given these results, the lack of histologic evaluation in this study might have led to misdiagnosis of MRPLNs and caused inaccurate analytical results. In addition, the dogs were evaluated using either of 2 different CT scanners based upon availability of the machine at the time of evaluation, which may have affected attenuation measurement. This lack of standardization may have affected overall results of the study. Future studies would be needed to enroll a larger number of MRPLNs and to standardize the procedures in order to reduce the operator variability.

In conclusion, based on our findings, ultrasound-guided aspiration of MRPLNs may have a low diagnostic yield in dogs. Increasing rostral height may increase the chances of obtaining diagnostic samples, thus, prior case selection based on CT evaluation may increase the probability of diagnostic samples. Overall, CT parameters of normal MRPLNs were consistent with what has been previously reported. Age and weight inclined to influence CT characteristics of MRPLNs; however, this finding might not be clinically significant. Future studies with standardization of procedures and a larger number of study subjects are needed to verify the findings in the present study.

Acknowledgment

The authors thank Jhoanne Marsh C. Gatpatan for her assistance in statistical analysis of this study.

References


Industry News
Nouvelles de l’industrie

Revolutionary New Tool for Diagnosing, Staging Osteoarthritis Introduced to Veterinarians at VMX

Elanco Animal Health Incorporated, together with the COAST Development Group, showcased a new diagnostic aid, ‘COAST’ (Canine OsteoArthritis Staging Tool) at the 2019 Veterinary Meeting & Expo (VMX) in Orlando, Florida.

“Until now, a standardized way hasn’t existed to diagnose and stage canine osteoarthritis with risk factor analysis in subclinical dogs,” said Dr. Mark Epstein, DVM, DABVP, CVPP. “I’m excited to highlight this tool that will revolutionize the way we approach osteoarthritis, with a goal of better outcomes for dogs with this debilitating disease.”

Canine Osteoarthritis (OA) is the most common cause of chronic pain in dogs. The current lack of a standardized system for staging osteoarthritis can lead to delayed diagnosis and inconsistent approaches to patient evaluation, monitoring and treatment. A progressive degenerative disease, OA is primarily driven by developmental orthopedic disease, and can affect young dogs. Although there is no cure for OA, timely diagnosis provides opportunities to implement a continuing patient care plan to control pain, to encourage appropriate levels of activity, and to maintain musculoskeletal health.

The lack of a standardized system for staging osteoarthritis can lead to delayed diagnosis and inconsistent approaches to patient evaluation, monitoring and treatment. The Canine OsteoArthritis Staging Tool (COAST) was developed by a consortium of nine clinical experts currently practicing small animal orthopedics, anesthesia and pain management. The COAST Development group included the following members: Drs. T. Cachon (France), O. Frykman (Sweden), J.F. Innes (UK), B.D.X. Lascelles (US), M. Okumura (Japan), P. Sousa (Iberia), F. Staffieri (Italy), P.V. Steagall (Canada), B. Van Ryssen (Belgium). The development of COAST has been made possible by the support of Elanco.

COAST is an easy-to-use standardized staging system for canine OA and can be used to stage all dogs, including those that are preclinical, but at-risk, as well as dogs with established signs of OA.

How COAST Works: A grade of severity is assigned to the affected joints as well as the dog as a whole, reflecting the extent to which OA is affecting the dog overall.

Consolidation of the grades into a measure of overall disease severity enables classification of the patient into one of five COAST stages of OA (Stage 0 to 4, ranging from preclinical with no risk factors to severe OA). Additionally, COAST incorporates input from both dog owners and veterinary clinical assessments and provides standardized scores over time that can be related to treatment efforts.

Full details of COAST are available as an open access peer-reviewed article published in The Veterinary Journal: https://www.sciencedirect.com/science/article/pii/S1090023318300583?via%3Dihub

The COAST Development group encourages the use of COAST in veterinary clinics in order to gain feedback for the further validation and optimization of the tool. Please contact the corresponding author, Dr. Duncan Lascelles, dlascel@ncsu.edu or the group e-mail COASTDevGroup@gmail.com, to learn more.
Do plasma protein:fibrinogen ratios in horses provide additional information compared with fibrinogen concentration alone?

Nicole J. Fernandez, Marie-France Roy

Abstract — The plasma protein:fibrinogen (PP:F) ratio was introduced to aid interpretation of hyperfibrinogenemia by accounting for dehydration. However, this ratio is inconsistently assessed in practice and its clinical value remains unknown. Our objective was to determine whether the PP:F ratio provides additional information in adult horses beyond fibrinogen concentration alone. Two databases were reviewed to identify 412 hyperfibrinogenemic horses. Plasma protein:fibrinogen ratios were calculated and their interpretation compared to the fibrinogen concentration. Ratios > 15 were supportive of inflammation. Albumin and total protein concentrations were evaluated when ratios were > 15 to determine if inflammation was supported. Very good agreement (86%) was found on the presence of inflammation when PP:F ratios were compared to fibrinogen concentration. In 72% of cases in which PP:F ratios did not support inflammation, inflammation was considered likely based on albumin and total protein. These findings suggest that PP:F ratios do not provide additional information in horses over fibrinogen concentrations alone.

Résumé — Est-ce que le ratio plasma protéine:fibrinogène chez les chevaux amène une information additionnelle par rapport à la seule concentration en fibrinogène? Le ratio plasma protéine: fibrinogène (PP:F) a été introduit pour aider à l’interprétation de l’hyperfibrinogénémie lors d’hémoconcentration. Toutefois, la valeur clinique de ce ratio est inconnue. Notre objectif était de déterminer si le ratio amène une information additionnelle comparé au fibrinogène. Deux bases de données ont été revues pour identifier 412 chevaux hyperfibrinogénémiques. Le ratio a été calculé et son interprétation comparée à celle du fibrinogène. Les ratios > 15 suggèrent l’inflammation. Pour les cas présentant un ratio > 15, la concentration en albumine et protéines totales a été revue pour voir si l’inflammation était possible. Nos résultats indiquent que dans 86 % des cas, le ratio et le fibrinogène suggèrent la présence d’inflammation. Pour 72 % des cas où le ratio ne suggère pas l’inflammation, cette dernière est considérée probable étant donné la concentration en protéines totales et albumine. Ces résultats suggèrent que le ratio PP:F n’apporte pas d’information supplémentaire comparé au fibrinogène.

(Traduit par les auteurs)

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Introduction

Early recognition of systemic inflammation is vital to providing effective treatment. Inflammation that goes undetected can result in delays in treatment and possibly poorer outcomes. Ideally, systemic inflammation would be detected during the initial diagnostic work-up. Fibrinogen is a moderate acute phase protein that can be easily estimated by heat precipitation and refractometry (fibrinogen HP) or measured more accurately through other methods such as the Clauss method (fibrinogen quant) (1). Although fibrinogen concentrations are not elevated until 24 to 72 h after the onset of inflammation, and although it is not a very sensitive indicator of inflammation, fibrinogen is frequently evaluated in equine practice (2).

The plasma protein:fibrinogen (PP:F) ratio was proposed several decades ago in a series of papers by Schalm et al (3,4), and is calculated as follows:

\[
\frac{\text{Plasma Protein (g/L) — Fibrinogen (g/L)}}{\text{Fibrinogen (g/L)}}
\]

The ratio was recommended to nullify the effect of hemocoagulation on fibrinogen concentration, especially with borderline elevations in fibrinogen of 1 to 2 g/L (4). Schalm et al (4) state that ratios < 15 reflect an absolute increase in fibrinogen concentration over plasma protein, and that ratios < 10 reflect a marked increase in fibrinogen and therefore serious disease in...
the horse and the dog. Inexplicably, the interpretation of the ratio varies depending on which veterinary textbook is consulted (5–10). It should be noted that only 13 clinically normal adult horses and 11 adult horses with inflammatory disease were evaluated in these early studies, and that plasma protein and fibrinogen concentrations were estimated using heat precipitation and refractometry.

Use of the PP:F ratio by veterinarians appears to be inconsistent. Anecdotally, the PP:F ratio is often advocated by veterinary clinical pathologists but is not widely used by equine clinicians. Upon perusal of veterinary resources, the ratio is mentioned in 5 clinical pathology textbooks (5–9), not mentioned in an online textbook on veterinary clinical pathology (11), and only mentioned in 1 of 4 large animal medicine texts (10,12–14). A query posted on the American Society for Veterinary Clinical Pathology listserv determined that 59% (10/17) of respondents use or teach the PP:F ratio; 82% (14/17) of respondents were American College of Veterinary Pathologists Board-certified clinical pathologists, 1 was a diplomate of the European College of Veterinary Clinical Pathology, and 2 had other qualifications. A similar query posted to the American College of Veterinary Internal Medicine equine internal medicine listserv revealed that 95% (18/19) of respondents (Board-certified equine internists) do not use or teach the PP:F ratio. Several equine internists reported *stia* the listserv that they were not aware of the ratio, and the 1 internist who reported teaching the ratio to students does not use it in clinical practice. Even Schalm (15) did not mention the PP:F ratio in a later study about fibrinogen in clinical disorders of horses.

In this study, we examined whether PP:F ratios provided additional information in adult horses, beyond that provided by fibrinogen concentration alone.

**Materials and methods**

In this retrospective study, fibrinogen and plasma protein (PP) concentrations were measured by different methods. In most horses (*n* = 377), fibrinogen and PP were estimated through heat precipitation and refractometry (16). Briefly, blood was collected by jugular venipuncture directly into EDTA vacutainer tubes. Microhematocrit tubes were filled with blood, sealed at one extremity, centrifuged for 5 min, heated for 3 min at 65°C, and centrifuged again. Plasma protein concentration was determined by refractometry before and after heating, and the difference in PP concentration was taken as an estimate of fibrinogen concentration (fibrinogen HP). In the remaining horses (*n* = 56), fibrinogen concentration was measured through the Clauss method, a quantitative measure of clottable fibrinogen (fibrinogen quant) (1). Among these, 50 horses had fibrinogen measured by both methods. For measurement of fibrinogen quant, blood was collected upon admission into citrate and heparin tubes. The citrated blood was centrifuged and the plasma harvested, frozen at −20°C for < 48 h, and then stored at −80°C for a maximum of 2 y until all samples were shipped together to the diagnostic laboratory (Animal Health Diagnostic Center, Cornell University, College of Veterinary Medicine, Ithaca, New York) where the fibrinogen quant was measured. The heparinized blood was used to measure PP as part of a chemistry panel done on-site at time of blood collection (using dry slide technology; IDEXX Catalyst Dx Chemistry Analyzer; IDEXX Laboratories Canada, Markham, Ontario).

Given the poor precision potentially associated with the heat precipitation method of fibrinogen measurement (16), we used 50 horses that had their fibrinogen concentration measured using both methods, on blood samples collected at the same time, to ensure that a fibrinogen HP cut-off of > 4 g/L was most likely to include only true hyperfibrinogenemic cases as measured by the Clauss method. This was done through evaluation of a 2 × 2 table and graphical representation of the paired data to calculate the fibrinogen HP false positive and false negative rates using the fibrinogen quant as the reference method. Additionally, Spearman correlation between the 2 methods was calculated (Prism 6 for Mac OS X; GraphPad software, La Jolla, California, USA).

Two databases were reviewed to identify horses with hyperfibrinogenemia (Databases 1 and 2) and to identify horses that had fibrinogen concentration measured by both methods (Database 1). Database 1 was a database of 479 consecutive adult (> 1 y old) horses admitted on an emergency basis to a private referral practice and described previously (17). From this database, we retrieved information on 41 horses with increase (> 4 g/L) fibrinogen HP and 56 horses with a fibrinogen quant measurement that could be used for the study. Among these, 29 were hyperfibrinogenemic (> 4.7 g/L) and had a recorded fibrinogen HP value, and were used for fibrinogen quant PP:F ratio calculation and for comparison of the fibrinogen quant and HP values.

![Figure 1. Comparison of the fibrinogen concentrations estimated through heat precipitation (Fibrinogen HP) or measured by the Clauss method (Fibrinogen quant). Fifty horses had fibrinogen measured by the 2 different methods, which showed moderate correlation (Spearman correlation: r = 0.73; *P* < 0.0001). Considering the Clauss method as the gold standard and a hyperfibrinogenemia cut-off of > 4 g/L for fibrinogen HP, the HP method gave a false negative rate of 55% (16/29) but a false positive rate of 0% (0/21). FP — false positive; TP — true positive; FN — false negative; TN — true negative.](attachment:image.png)
PP:F ratios (\(\text{PP} - \text{Fib}\)/Fib) were calculated and evaluated from the total protein concentration. The concentration of globulins was calculated by subtracting the albumin concentration from the biochemical panel (determined spectrophotometrically, Hitachi Cobas c311 chemistry analyzer; Roche Canada, Laval, Quebec) were also recorded when available. The concentration of fibrinogen was measured by both the heat precipitation method and the Clauss method. For cases from Database 1 that had fibrinogen measured by both methods revealed a moderate correlation \((r = 0.73; P < 0.0001)\). Considering the Clauss method as the gold standard and a hyperfibrinogenemia cut-off of \(4.7 \text{ g/L}\), the PP:F ratio of \(15\) reflected an absolute increase in fibrinogen and were supportive of inflammation, while ratios \(\geq 15\) were not supportive of inflammation. Agreement between the interpretation of the ratio and fibrinogen concentration for supporting inflammation was assessed using overall percent agreement (observed proportion of agreement). When there was disagreement between the interpretation of the ratio and fibrinogen concentration in cases from Database 2 (i.e., when the fibrinogen concentration was \(> 4 \text{ g/L}\) but the ratio was \(\geq 15\)), albumin, globulins, and total protein concentrations were evaluated when available. Hypoalbuminemia \((< 27 \text{ g/L})\), hyperglobulinemia \((> 41 \text{ g/L})\), and increased total protein concentration \((> 74 \text{ g/L})\) were considered supportive of inflammation as the cause of hyperfibrinogenemia. Albumin concentrations within reference intervals \((27 \text{ to } 36 \text{ g/L})\), but with concurrent hyperglobulinemia and/or increased total protein concentration, were also considered supportive of inflammation as the cause of hyperfibrinogenemia.

### Results

**Comparison of fibrinogen measurement by different methods**

Pairwise comparison of fibrinogen HP and fibrinogen quant concentration from 50 horses from Database 1 that had fibrinogen measured using both methods revealed a moderate correlation (Figure 1; Spearman correlation: \(r = 0.73; P < 0.0001\)). Considering the Clauss method as the gold standard and a hyperfibrinogenemia cut-off of \(> 4 \text{ g/L}\) for fibrinogen HP, the

<table>
<thead>
<tr>
<th>PP:F Ratio</th>
<th>Fibrinogen &gt; 4 g/L</th>
<th>Fibrinogen &gt; 4.7 g/L</th>
<th>Fibrinogen &gt; 4 g/L</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Heat precipitation</td>
<td>Clauss method</td>
<td>Heat precipitation</td>
</tr>
<tr>
<td>Database 1</td>
<td></td>
<td></td>
<td>Database 2</td>
</tr>
<tr>
<td>Ratio &lt; 15: Inflammation</td>
<td>34</td>
<td>34</td>
<td>285</td>
</tr>
<tr>
<td>Ratio ≥ 15: No inflammation</td>
<td>7</td>
<td>1</td>
<td>51</td>
</tr>
<tr>
<td>Total:</td>
<td>41</td>
<td>35</td>
<td>336</td>
</tr>
<tr>
<td>Percent agreement:</td>
<td>83%</td>
<td>97%</td>
<td>85%</td>
</tr>
</tbody>
</table>

**Table 2.** Results from Database 2: Evaluation of serum albumin, globulins, and total protein concentration in cases with PP:F ratios \(\geq 15\) \((n = 36)\).

<table>
<thead>
<tr>
<th>Albumin concentration</th>
<th>Globulins and total protein concentration</th>
<th>Likely reason for increased fibrinogen HP</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreased</td>
<td>Hyperglobulinemia and increased TP concentration.</td>
<td>Inflammation</td>
<td>12</td>
</tr>
<tr>
<td>Within reference interval</td>
<td>Hyperglobulinemia AND increased TP concentration.</td>
<td>Inflammation</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Hyperglobulinemia OR increased TP concentration.</td>
<td>Inflammation</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Globulins and TP within reference interval.</td>
<td>Unclear</td>
<td>8</td>
</tr>
<tr>
<td>Increased</td>
<td>Globulins and TP within reference interval.</td>
<td>Dehydration</td>
<td>1</td>
</tr>
</tbody>
</table>

TP — total protein.

6 had an increased fibrinogen quant but no fibrinogen HP value recorded, and were used for calculation of the fibrinogen quant PP:F ratio only; finally, 21 had a fibrinogen quant within the reference interval and were used only for the comparison between the fibrinogen quant and HP values. Thirteen horses from Database 1 were hyperfibrinogenemic with both measurement methods and were used for calculation of the PP:F ratio in the fibrinogen HP and the fibrinogen quant groups.

Database 2 was an archive of all samples submitted to a regional diagnostic laboratory (Prairie Diagnostic Services, Saskatoon, Saskatchewan) between June 2014 and June 2018. Fibrinogen and plasma protein were estimated through heat precipitation and refractometry as part of every equine complete blood (cell) count (CBC).

Cases were selected for inclusion in the study from both databases based on the presence of hyperfibrinogenemia. For the heat precipitation method, this included horses with fibrinogen HP \(> 4 \text{ g/L}\), in accordance with published reference intervals (2). For the Clauss method, horses with a fibrinogen quant \(> 4.7 \text{ g/L}\) were included, in accordance with the reference interval provided by the diagnostic laboratory. For cases from Database 2, serum albumin and total protein concentrations from the biochemical panel (determined spectrophotometrically, Hitachi Cobas c311 chemistry analyzer; Roche Canada, Laval, Quebec) were also recorded when available. The concentration of globulins was calculated by subtracting the albumin concentration from the total protein concentration.

For each case (Database 1: \(n = 76\); Database 2: \(n = 336\)), PP:F ratios (\(\text{PP} - \text{Fib})/\text{Fib}\) were calculated and evaluated to determine if they supported the presence of inflammation. As per Schalm (4), PP:F ratios of \(< 15\) reflected an absolute increase in fibrinogen and were supportive of inflammation, while ratios \(\geq 15\) were not supportive of inflammation.
HP method gave a false negative rate of 55% (16/29) but a false positive rate of 0% (0/21). These findings are similar to a previous study (16) examining the accuracy of heat precipitation and refractometry to estimate fibrinogen concentrations and suggest that horses with a fibrinogen HP > 4 g/L can be classified as hyperfibrinogenemic.

Comparison of fibrinogen concentration and the PP:F ratio

From Database 1, 76 hyperfibrinogenemic horses were identified. Among these, 41 horses had fibrinogen and plasma protein estimated by refractometry and heat precipitation, and 35 horses had fibrinogen measured quantitatively by the Clauss method and plasma protein concentration measured on site with dry slide technology. Thirteen horses had fibrinogen measured by both methods and were included in both groups. The PP:F ratios calculated from cases in Database 1 ranged from 6.5 to 18.2 for the fibrinogen HP group and from 5.1 to 15.5 for the fibrinogen quant group.

For the fibrinogen HP group, 34 of 41 cases (83%) had an estimated fibrinogen and a PP:F ratio that both supported inflammation (Table 1). The remaining 7 cases had a fibrinogen HP that supported inflammation but a PP:F ratio that did not support inflammation.

For the fibrinogen quant group, 34 of 35 cases (97%) had a fibrinogen concentration and a PP:F ratio that both supported inflammation. The remaining case had a fibrinogen quant that supported inflammation but a PP:F ratio that did not.

From Database 2, 336 hyperfibrinogenemic samples were identified. The PP:F ratios ranged from 3.2 to 20.6. Of these samples, 285 (85%) had a fibrinogen HP and a PP:F ratio that both supported inflammation but a PP:F ratio that did not.

In all cases from both databases, disagreement between the fibrinogen concentration and the PP:F ratio on the presence of inflammation was noted only when the fibrinogen concentration was mildly increased (fibrinogen HP = 5 or 6 g/L (n = 7, Database 1 and n = 51, Database 2); fibrinogen quant = 4.9 g/L (n = 1, Database 1)). There was no disagreement in any case with a fibrinogen HP concentration > 6 g/L or a fibrinogen quant concentration > 4.9 g/L.

The cases from Database 2 in which there was disagreement were further evaluated. Serum albumin and total protein concentration were available from the biochemical panel in 36 of the 51 samples (Table 2). In 72% of these cases (26/36) in which the PP:F ratios did not support inflammation, inflammation was considered likely following review of albumin and total protein.

Discussion

The PP:F ratio was proposed decades ago as an aid in determining whether hyperfibrinogenemia is due to inflammation by nullifying any effect of hemoconcentration. In the original studies, Schalm et al (3) first evaluated the PP:F ratio in 13 clinically normal horses and found that the PP:F ratio ranged from 18 to 35. Secondarily, Schalm (4) evaluated 11 adult horses with various inflammatory diseases and found that the PP:F ratio ranged from 7 to 16 in 9 horses with hyperfibrinogenemia (fibrinogen > 4 g/L). In 2 normofibrinogenemic horses, the ratios were 19 and 25 (4). In the third study, Schalm (18) measured fibrinogen concentrations in routine clinical material from 982 horses with a wide variety of conditions ranging from near normal to advanced disease, but did not measure plasma protein concentration or calculate PP:F ratios. From these results and similar measurements in cattle, dogs, and cats, Schalm et al (3) concluded that ratios < 15 reflect an absolute increase in fibrinogen concentration over plasma protein, and that ratios < 10 reflect a marked increase in fibrinogen and therefore serious disease.

Based on these limited studies, the PP:F ratio was included in veterinary textbooks. Some authors suggest that ratios > 20 reflect dehydration (5,10) or that ratios between 10 and 15 only reflect possible inflammation and that other clinical data should be considered (9,10); however, none of these suggestions are in the original articles. Another common statement is that the ratio should not be used in foals or in hypoproteinemic animals (5,6,9), but again, this is not found in the original articles.

Our study investigated whether the PP:F ratio provides additional information compared with the fibrinogen concentration alone. We used the original guidelines for interpretation of the PP:F ratio, namely that ratios < 15 reflect an absolute hyperfibrinogenemia and therefore inflammation, and that ratios > 15 do not support inflammation. We found subjectively very good agreement between the interpretation of fibrinogen concentration and the PP:F ratio, with overall 86% of the cases having both a fibrinogen concentration and a ratio that supported inflammation, and no disagreement when the fibrinogen concentration was > 6 g/L. This high agreement alone suggests that there is little additional information to be gained by calculating the PP:F ratio.

The remaining cases (14%; 59/412) had mildly increased fibrinogen concentrations and PP:F ratios > 15 that did not support inflammation as the cause of the hyperfibrinogenemia. We were able to further evaluate 36 of these cases by examining serum albumin, globulins, and total protein concentrations. In 26 of these cases, the additional data pointed to inflammation as the likely cause of the hyperfibrinogenemia. This suggests that the PP:F ratio misclassified the cause of hyperfibrinogenemia in 72% of the cases in which information on serum proteins was available. In 1 case, hyperfibrinogenemia appeared to be due to dehydration (based on the presence of hyperalbuminemia), which agrees with a PP:F ratio > 15 that does not support an inflammatory cause. In the remaining 9 cases, including 1 hypoproteinemic case, the albumin and total protein concentrations were not helpful in determining the cause of the hyperfibrinogenemia.

Although an extensive evaluation of cases with increased ratios, including examination of the medical record where available, may have been useful in establishing inflammation as the cause of hyperfibrinogenemia, this was beyond the scope of our study. We recognize that albumin and total protein concentrations are not foolproof indicators of inflammation; we chose to use them rather than other laboratory data such as leukogram changes because of their more straightforward interpretation compared to the leukogram (19). The leukogram may also be
unremarkable in horses with a presumed inflammatory hyperfibrinogenemia (19). In addition, we assumed that the hyperglobulinemia was due to polyclonal inflammatory increases in the globulin fractions (rather than due to B-lymphoid neoplasia, which would be rare in the horse), but this was not confirmed by serum protein electrophoresis. We also assumed that hypalbuminemia in the presence of hyperglobulinemia and/or hyperproteinaemia reflected decreased production due to the role of albumin as a negative acute phase protein rather than renal or gastrointestinal albumin loss (2). It may have been better to evaluate other acute phase proteins such as serum amyloid A or gastrointestinal albumin loss (2). It may have been better to evaluate other acute phase proteins such as serum amyloid A or gastrointestinal albumin loss (2). It may have been better to evaluate other acute phase proteins such as serum amyloid A or gastrointestinal albumin loss (2). It may have been better to evaluate other acute phase proteins such as serum amyloid A or gastrointestinal albumin loss (2). It may have been better to evaluate other acute phase proteins such as serum amyloid A or gastrointestinal albumin loss (2). It may have been better to evaluate other acute phase proteins such as serum amyloid A or gastrointestinal albumin loss (2). It may have been better to evaluate other acute phase proteins such as serum amyloid A or gastrointestinal albumin loss (2). It may have been better to evaluate other acute phase proteins such as serum amyloid A or gastrointestinal albumin loss (2). It may have been better to evaluate other acute phase proteins such as serum amyloid A or gastrointestinal albumin loss (2). It may have been better to evaluate other acute phase proteins such as serum amyloid A or gastrointestinal albumin loss (2).

The PP:F ratio is based on the premise that during inflammation, the fibrinogen concentration increases proportionally more than the total plasma protein concentration; while during dehydration, the fibrinogens and plasma protein concentrations increase proportionally (5). While this may be true in theory, in practice, there are many variables that influence the PP:F ratio. First, as indicated by Schalm et al (3), the plasma protein concentration increases with age and thus the “normal range” of PP:F ratio most likely changes with age as well. Thus, the proposed cut-off of <15 as supportive of inflammation may only be applicable to a certain age group. Second, while it is true that during inflammation, some proteins increase while others decrease, in many chronic conditions, the plasma protein concentration can increase markedly due to hyperglobulinemia. This can lead to a high (≥15) PP:F ratio despite inflammation being the cause of hyperfibrinogenemia. This may be especially true when the fibrinogen concentration is estimated by heat precipitation and refractometry since, based on our results and others (16), this technique is less precise and can underestimate the fibrinogen concentration. Finally, many other factors related to the condition affecting the horse can influence the PP:F ratio, including diseases associated with protein losses, consumption of fibrinogen, or a combination of dehydration and protein loss with or without fibrinogen consumption. Given the many factors that can influence the PP:F ratio, it seems unlikely that this simple ratio can consistently and accurately confirm inflammation in all cases. While the possibility exists that a mild increase in fibrinogen (5 or 6 g/L) could be due to dehydration rather than inflammation, clinicians should rely on their physical examination and clinicopathological findings to ensure proper assessment and treatment of their patients.

In conclusion, our study suggests that the PP:F ratio, as originally proposed, does not provide additional useful information compared to the fibrinogen concentration alone. This is based on the high percent agreement on inflammation as the cause of hyperfibrinogenemia when comparing the fibrinogen concentration and the PP:F ratio, on the likelihood that the PP:F ratio misclassifies cases of inflammation when the ratio is ≥15, and on the very sparse scientific evidence to support the value of the PP:F ratio in previous literature, despite the ratio being mentioned in several textbooks. While the premise underlying the PP:F ratio seems plausible, the variety and complexity of clinical cases limits the usefulness of the ratio. In cases with borderline increases in fibrinogen concentrations, clinicians can rely on physical and other clinicopathological findings to decide whether the hyperfibrinogenemia is truly due to inflammation.

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References
Diagnostic imaging characteristics of canine infectious sacroiliitis

Robert Slater, Alex zur Linden, Fiona James

Abstract — Infectious sacroiliitis has not been described in dogs. This retrospective case series describes the presentation, diagnostic imaging characteristics, and outcomes of 2 canine patients with infectious sacroiliitis. Selection criteria included presentation with back pain from 2010 to 2017, diagnostic imaging of the sacroiliac joints, and short- and long-term response to antibiotic therapy. Medical records, and magnetic resonance imaging (MRI) were reviewed by a Board-certified veterinary radiologist, a neurologist, and a small animal intern. Two dogs met the inclusion criteria. Magnetic resonance imaging revealed unilaterally wide and irregular sacroiliac joint spaces, with juxta-articular soft tissue contrast enhancement and bone marrow edema. One patient had a communicating abscess of the psoas muscle, which cultured positive for Pasteurella canis. Following treatment with pain relief medications and antibiotics, both patients made a complete clinical recovery, with no signs of lameness 2 to 4 weeks after cessation of treatment, and no lameness reported by the owner afterwards. Infectious sacroiliitis should be considered when dogs are presented with lumbosacral pain.

Résumé — Caractéristiques de l’imagerie diagnostique de la sacro-iliaite infectieuse canine. La sacro-iliaite infectieuse n’a pas été décrite chez les chiens. Cette série de cas rétrospectifs décrit la présentation, les caractéristiques de l’imagerie diagnostique et les résultats de deux patients canins atteints de sacro-iliaite infectieuse. Les critères de sélection incluaient la présentation avec des douleurs au dos de 2010 à 2017, l’imagerie diagnostique des articulations sacro-iliaques et une réponse à court et à long terme à la thérapie aux antibiotiques. Les dossiers médicaux et l’imagerie à résonance magnétique (IRM) ont été évalués par un radiologiste vétérinaire agréé, un neurologue et un interne en médecine des petits animaux. Deux chiens satisfaisaient aux critères d’inclusion. L’imagerie à résonance magnétique a révélé des espaces d’articulation sacro-iliaque unilatéralement larges et irréguliers avec une augmentation de contraste des tissus mous juxta-articulaires et de l’œdème de la moelle osseuse. Le patient 2 avait un abcès communiquant du muscle psoas qui a révélé la présence de Pasteurella canis à la culture. Après un traitement avec des médicaments analgésiques et des antibiotiques, les deux patients ont connu un rétablissement clinique complet sans signes de boiterie de 2 à 4 semaines après l’arrêt du traitement et aucune boiterie n’a été signalée par la suite par le propriétaire. La sacro-iliaite infectieuse devrait être considérée lorsque les chiens sont présentés avec des douleurs lombo-sacrées.

(Traduit par Isabelle Vallières)

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Introduction

Back pain is a common presenting complaint in dogs, with some of the main causes being intervertebral disc herniation, lumbosacral stenosis, discospondylitis, and trauma (1–4). Amongst the differential diagnoses for back pain in dogs, sacroiliac conditions are rarely reported. Nontraumatic sacro-iliac conditions previously described in dogs include ankylosis capsularis ossea, pelvic ring anomaly, and vertebral anomalies (5,6). Ankylosis capsularis ossea is characterized by large bridging osteophytes formed at the cranioventral margin of the wing of the sacrum and adjoining ilium (5). Pelvic ring anomaly is defined by bony alteration at the caudal end of the canine sacrum (6). It has been suggested that these 2 conditions may be the same degenerative disorder at the edge of the joint, and not primarily intra-articular (5,7).

In humans, sacroiliitis is a disease primarily affecting the articular surface of the sacroiliac joint. In 14% to 22% of cases of lower back pain, the sacroiliac joint is the primary cause (8,9). The most common cause of sacroiliac pathology in humans is an inflammatory, non-infectious condition called ankylosing spondylarthropathy, found in about 0.1% to 1.4% of the general population (10). Other causes include bacterial
infection, neoplasia and trauma (11–15). Clinical signs of infectious sacroiliitis in humans include lumbogluteal, psoas, and sacroiliac pain; the associated diagnostic imaging characteristics of infectious sacroiliitis have been described (11).

The objectives of this study were to identify cases of infectious sacroiliitis at the Ontario Veterinary College (OVC) that had diagnostic imaging performed, describe the diagnostic imaging findings, presenting clinical signs, history, and response to treatment. To the best of the authors’ knowledge, this is the first report to describe magnetic resonance (MR) characteristics of canine infectious sacroiliitis and compare the imaging findings to the comparative human condition.

Materials and methods
A retrospective, descriptive, case series was reviewed at the OVC Companion Animal hospital. Medical records were searched from 2010 to 2017 to identify canine cases with reported or suspected infection of the sacroiliac joint. Inclusion criteria for the study included pain on palpation of the lumbar spine, pathological changes to the sacroiliac joint on standardized diagnostic imaging studies, and either positive culture or a positive clinical response to antibiotic therapy. Inclusion criteria, identified cases, and diagnostic imaging were reviewed by all of the authors, including a small animal rotating intern (R.S.), an American Board-certified veterinary radiologist (A.Z.), and an American Board-certified neurologist (F.J.). For each case included, the following data were recorded from the medical records: signalment, initial onset of lameness, duration of lameness, clinical findings on physical examination, diagnostic imaging abnormalities, treatment received, and clinical response to therapy. Magnetic resonance imaging (MRI) studies included the entire lumbar spine and sacroiliac joints for each patient, and images according to standardized protocols established at the OVC. All images were reviewed using digital imaging and communications in medicine (DICOM) viewing software (OsiriX MD, v.8.0.2; Pixmeo Sarl, Bernex, Switzerland) on a dedicated workstation. The imaging findings were discussed by the 3 reviewers with consensus findings reported.

Magnetic resonance imaging scans were performed using a standard protocol on a 1.5 T unit (GE 1.5 Signa Explorer; General Electric Healthcare, Milwaukee, Wisconsin, USA) with patients under general anesthesia. The MRI studies were performed using a receive only, phased array, 12-element, 8-channel radiofrequency coil (Premier 9000 8-channel CTL coil, USA Instruments, Aurora, Ohio, USA). Briefly, the MRI sequences were conducted in 3 planes including dorsal, sagittal, and transverse relative to the long axis of the lumbar spine. Sequences acquired included T2-weighted (TR 3200–5200 ms, TE 85 ms, 2.00 mm, NEX 4) fast-spin echo in sagittal and transverse planes; T1-weighted (TR 416 ms, TE 11 ms, 3.00 mm, NEX 4) fast-spin echo in transverse and sagittal planes, with and without fat saturation, pre- and post-contrast medium administration at 0.1 mmol/kg body weight (BW) (gadobenate dimeglumine, 529 mg/mL, Bracco, Anjou, Quebec); dorsal short tau inversion recovery (TR 4150 ms, TE 49 ms, 3.00 mm, inversion time 150 ms, NEX 4), and dorsal T2 IDEAL (in phase, TR 4249 ms, TE 81.984 ms, 2.00 mm, NEX 3).

Results
Two dogs met the inclusion criteria: an 11-year-old female spayed golden retriever (Patient 1) and a 4-month-old male intact boxer (Patient 2). Both dogs were clinically lame in 1 or both of the pelvic limbs at the time of presentation. Patient 1 had displayed lameness for 2 wk. Patient 2 had an acute lameness of less than 24 h in duration. Diagnosis in Patient 2 was confirmed with bacterial culture results from aspiration of a communicating abscess. Patient 1 was diagnosed based on the successful permanent resolution of clinical signs within 48 h of starting empirical antibiotic therapy.

Patient 1 had a concurrent nasal adenocarcinoma, diagnosed 1 mo before presentation for the pelvic limb lameness. This patient underwent a 2-week, 10-fraction course of radiotherapy after diagnosis of the tumor. Following the radiotherapy, the patient received 14 d of meloxicam, amoxicillin clavulanate, tramadol, and gabapentin (Table 1) for control of pain, inflammation, and secondary infection. Four days after finishing the course of radiotherapy, the patient began displaying pelvic limb shaking and lameness that continued for 2 wk until presentation. Patient 2 had concurrent chronic diarrhea since adoption 6 wk before presentation. The diarrhea was refractory to multiple courses of metronidazole, at 10 mg/kg BW, PO, q12h (Table 1). Right pelvic limb lameness developed acutely 1 d before presentation.

Lumbosacral pain and delayed pelvic limb postural reactions were the common physical examination findings in both patients. The paresis and postural reaction delays were lateralized in Patient 1. Both patients experienced paresis of 1 or both pelvic limbs and significant pelvic limb lameness. Both patients underwent MRI scans of the lumbar spine and sacroiliac joints. The representative image findings are illustrated for Patient 1 in Figure 1 and for Patient 2 in Figure 2.

Unilaterally increased T2 signal intensity was found on MRI of Patients 1 and 2, as well as high STIR signal intensity of sacroiliac periarticular musculature and contrast enhancement of these same areas. Both cases showed contrast enhancement of the fibrous and cartilaginous portions of a single sacroiliac joint and a widened and irregular margination of the sacroiliac joint space and increased joint fluid. Decreased T1 and T2 signal intensity of the medullary cavity of the ilial wing, body, and sacrum was noted in Patient 1. Further changes included patchy contrast enhancement of the medullary cavity (Patient 1), the ilial wing (both patients), ilial body (both), and sacrum (both). The MRI of Patient 2 revealed a tubular-shaped structure, communicating with the ventral aspect of the widened right sacroiliac joint, and extending into the pelvic canal, dorsally displacing the colon and the urethra. This structure contained fluid, consistent with an abscess.

The signalment, presenting complaint, physical examination findings, diagnostic imaging findings, prescribed treatments, outcome, and risk factors are summarized for both patients in Table 1.

For Patient 2, aspiration of the tubular structure that extended ventrally from the right sacroiliac joint and surrounding...
ARTICLE

no signs of lameness 6 mo after original presentation.

Through the cribriform plate. Patient 2 remained healthy, with eventually euthanized due to changes in mentation, suspected patient after discontinuation of antibiotic therapy. Patient 1 was recheck for Patient 2. No relapse in lameness was noted in either addition to pain relief medications (Table 1). At a 6-week

lar to those identified in these dogs. They include a widened

Characteristic signs of infectious sacroiliitis in humans are similar to those identified in these dogs. They include a widened and irregular joint space, contrast enhancement of the articular structures, increased joint fluid, bone marrow edema and periarticular soft tissue edema, and contrast enhancement. In some cases, a communicating abscess can be identified. An MRI of Patient 2 and that of a human patient diagnosed with infectious sacrococcygitis (Figure 3) demonstrate the striking similarities of the condition in both species.

The canine sacroiliac joint is comprised of 2 histologically separate regions — hyaline and ligamentous. The caudalventral third is composed of hyaline cartilage, a diarthroidal joint (16). A zone of transition then leads to the ligamentous structures, increased collagen fibers and adipose tissue (16,17). The articular surface is contoured and roughened, with thicker subchondral bone at ligament attachment sites. In rat models, sensory innervation of the ventral sacroiliac joint originates from the dorsal root ganglia of the lower lumbar and sacral levels (L1-S2) (18). The craniodorsal sacroiliac joint innervation originates from the dorsal root ganglia of the rostral and caudal lumbar, and sacral levels (L1-S2) (18). If canine patient anatomy is comparable, then pain may be elicited at this level. In humans, lower back pain, elicitation of pain at the sacroiliac joint through manipulation, and relief

**Table 1.** Tabulated data for 2 dogs diagnosed with infectious sacroiliitis including signalment, presenting complaint, physical examination findings, diagnostic imaging findings, prescribed treatments, outcome, and risk factors.

<table>
<thead>
<tr>
<th>Patient</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breed</td>
<td>Golden retriever</td>
<td>Boxer</td>
</tr>
<tr>
<td>Signalment</td>
<td>11 y old, female spayed</td>
<td>4 mo old, male intact</td>
</tr>
<tr>
<td>History</td>
<td>Back pain on palpation, pelvic limb lameness</td>
<td>1 d of pelvic limb lameness, chronic diarrhea</td>
</tr>
<tr>
<td>Physical examination</td>
<td>Paraparesis</td>
<td>Generalized muscle wasting in the hind end. Non-weight-bearing on the right pelvic limb.</td>
</tr>
<tr>
<td>Imaging modality</td>
<td>MRI</td>
<td>MRI</td>
</tr>
<tr>
<td>Imaging findings</td>
<td>Periarticular soft tissue contrast enhancement.</td>
<td>The right SIJ is widened, with increased intra-articular fluid.</td>
</tr>
<tr>
<td>Therapy</td>
<td>Clindamycin, Prednisone, Tramadol</td>
<td>Enrofloxacin, Amoxicillin clavulanate, Metronidazole, Sulfadimethoxine, Gabapentin</td>
</tr>
<tr>
<td>Outcome</td>
<td>Clinical resolution at 6 wk</td>
<td>Clinical resolution at 2 wk</td>
</tr>
<tr>
<td>Risk factors</td>
<td>Nasal tumor, antibiotic therapy, Radiation therapy</td>
<td>Chronic diarrhea, antibiotic therapy</td>
</tr>
</tbody>
</table>

* Clindamycin (Apotex, Toronto, Ontario), 13 mg/kg BW, PO, q12h, 6 wk. Tramadol (Chiron Compounding Pharmacy, Guelph, Ontario), 3 mg/kg BW, PO, q8h, 14 d. Prednisone (Apotex), 1 mg/kg BW, q24h for 7 d, 0.73 mg/kg BW, q24h for 7 d, 0.36 mg/kg BW, q24h for 7 d, 0.18 mg/kg BW, q24h for 7 d.
* Enrofloxacin (Baytril; Bayer Animal Health, Mississauga, Ontario), 6 mg/kg BW, q24h for 5 d. Amoxicillin and clavulanic acid (Clavamox; Zoetis, Kirkland, Quebec), 15.6 mg/kg BW, q12h for 4 wk. Metronidazole (AA Pharma, Vaughan, Ontario), 10 mg/kg BW, q12h for 14 d. Sulfadimethoxine (Chiron Compounding), 700 mg, q24h for 7 d. Gabapentin (Auro Pharma, Woodbridge, Ontario), 100 mg, q8h for 10 d. Fortiflora: (Nestle Purina PetCare Company, Caledonia, Ontario) 1/2 a packet q12h for 10 d.

Both patients were placed on antibiotics for 4 to 6 wk, in addition to pain relief medications (Table 1). At a 6-week recheck, no signs of pain or neurological deficits were seen with Patient 1. Clinical resolution of lameness was seen at a 2-week recheck for Patient 2. No relapse in lameness was noted in either patient after discontinuation of antibiotic therapy. Patient 1 was eventually euthanized due to changes in mentation, suspected to be a consequence of the nasal adenocarcinoma and invasion through the cribriform plate. Patient 2 remained healthy, with no signs of lameness 6 mo after original presentation.

**Discussion**

Characteristic signs of infectious sacroiliitis in humans are similar to those identified in these dogs. They include a widened

musculature revealed numerous variably degenerate neutrophils and low numbers of macrophages. Occasional intracellular pleomorphic bacteria (rods of various sizes, coccobacilli) were observed, with rare osteoclasts. An abscess with secondary bone involvement was diagnosed. The patient was taken to surgery to debride the abscess; on submission to histology the tissue revealed pleomorphic bacteria (rods of various sizes, coccobacilli) were occasional intracellular muscle revealed numerous variably degenerate neutrophils and low numbers of macrophages. Occasional intracellular pleomorphic bacteria (rods of various sizes, coccobacilli) were observed, with rare osteoclasts. An abscess with secondary bone involvement was diagnosed. The patient was taken to surgery to debride the abscess; on submission to histology the tissue revealed pleomorphic bacteria (rods of various sizes, coccobacilli) were occasional intracellular
of pain when the joint is injected with local anesthetic, are all key to the diagnosis of sacroiliac pain (19,20). As there are no accurate methods reported to anesthetize the sacroiliac joints in dogs, elicitation of lumbosacral pain on palpation appears to be the common physical examination finding, in addition to a delay in pelvic limb postural reactions (21,22).

The imaging findings associated with infectious sacroiliitis in the dogs herein are typical of inflammatory lesions seen on MRI in humans. Inflammation can be divided into active acute and structural chronic findings. Active acute inflammation presents as proliferative connective tissue, characterized by osteitis, enthesitis, capsulitis, synovitis, contrast enhancement, and articular effusion (23). Chronic structural changes include osteoproliferation, subchondral sclerosis/erosions, transarticular bone bridges, fibrocartilaginous enhancement, and pannus formation (24,25). Many of these signs were seen on the MR studies of

Figure 1. Representative magnetic resonance (MR) images for Patient 1. Transverse plane images at the level of the caudal half of the sacroiliac joints including A — T2 FSE, B — T1 FSE, C — T1 FSE + contrast, D — T1 FSE + contrast and fat saturation. Dorsal plane images at the level of the sacroiliac joints including E — STIR, T1 FSE + contrast with fat saturation. Centered on the right sacroiliac joint, the muscles adjacent to the ilium and sacrum have a mild increased T2 signal intensity (A), a high signal on STIR (E), and strongly contrast enhance (C, D, F), compared with the left side. The fibrous and cartilaginous portions of the right sacroiliac joint exhibit marked contrast enhancement, widening of the joint space, with irregular margins (C, D, F). Contrast enhancing tissue extends from the dorsal aspect of the right sacroiliac joint, through the right S1 intervertebral foramen, and into the right side of the epidural space (arrow). Within the right ilial wing and extension into the body and right side of the sacrum, the medullary cavity has a moderately decreased T1 signal (B), a mildly decreased T2 signal (A), and exhibits mild patchy contrast enhancement (C, D, F).
the 2 dogs. Some of these chronic boney changes can be seen on radiographs; however, this modality has a low sensitivity (~22%) in the human literature, due to its inability to detect acute changes (26). Thus, radiographs can be a good first step for ruling in sacroiliitis. Due to their poor sensitivity, if sacroiliitis is not detected then advanced imaging is recommended.

With both patients, characteristic MRI findings included periarticular muscle contrast enhancement, joint space widening, increased joint space fluid, and bone marrow edema. Magnetic resonance imaging scans are the most effective tool for assessment of acute inflammatory sacroiliac changes in humans, with the abnormalities best seen on T2-weighted sequences and T1-weighted post contrast studies (26). The lesions on MRI noted in both patients were best seen on T2-weighted sequences and T1-weighted sequences with contrast and fat saturation. The fat saturation helped to highlight the contrast enhancement of the medullary cavity of the ilium and sacrum when the normal fatty marrow is suppressed (Figure 2C compared to Figure 2D). In humans this modality has a sensitivity of 71%
and specificity of 94%, one study showing 39.5% of patients positive for sacroilitis on MRI had no radiographic changes (26). Magnetic resonance imaging is superior to computed tomography (CT) for evaluation of sacroilitis (27). Computed tomography has a high sensitivity for detecting juxta-articular bone demineralization and joint space changes, and can detect sacroilitis earlier in its development compared with radiography, but is less accurate than MRI when assessing intra-articular and soft tissue changes (27).

Differentiating the cause of sacroilitis is vital in planning therapeutic management. Infectious sacroilitis will require administration of antibiotics (28), whereas the non-infectious condition of ankylosing spondylarthritis requires very different management (29). Misdiagnoses could lead to deterioration of the patient and sepsis, or misuse of antibiotics (30). Both patients displayed unilateral pathology. The human literature has shown that most infectious sacroilitis cases display unilateral pathology, with the only exception being bilateral pathology seen in 13% of pregnant patients (11). Ankylosing spondylarthritis presents in most cases (87%) with bilateral changes, the remaining unilateral cases being early in the disease, eventually becoming bilateral (31). It follows that infectious sacroilitis cannot be definitively diagnosed based on unilaterality, as this may represent an early case of ankylosing spondylarthritis. This is especially relevant in veterinary medicine, in which sacroilitis in general practice may mostly be diagnosed on radiographs. This modality cannot detect acute changes, and therefore if pathology is not equally distributed to each sacroiliac joint, the process may be misdiagnosed as unilateral and therefore incorrectly assumed to be infectious.

Magnetic resonance imaging is the only modality which can reliably distinguish between unilateral infectious sacroilitis and ankylosing spondylarthritis in humans (32). Periarticular muscle edema occurs more commonly with infectious sacroilitis, and is the only independent differentiating variable, with non-infectious, ankylosing spondylarthritis identified in 77.3% of cases, and infectious sacroilitis identified in 90% (32). Other extra-articular pathology is found more commonly with infectious sacroilitis, such as thick capsulitis, extracapsular fluid collection, and obvious abscesses (11,32). Some imaging characteristics are more common with non-infectious sacroilitis, such as edema of the bone marrow, found mostly in the iliac portion of the sacroiliac joint (32). Both patients herein had extensive extra-articular pathology, with periarticular myositis, contrast enhancement of the adjacent bone, as well as an abscess in Patient 2. Neither patient demonstrated iliac dominant bone marrow edema. The abscess in Patient 2 cultured positive for Pasteurella canis, part of the normal flora in dogs, similar to the human literature in which commonly isolated bacteria include methicillin-resistant Staphylococcus aureus (MRSA), coagulase negative Staphylococcus, Streptococcus, and Pseudomonas (11,33). No methods of successfully aspirating the canine sacroiliac joint have been described in the veterinary literature. Descriptions exist of ultrasound-guided joint injections but these were not sufficiently accurate to gain access to the sacroiliac joint (21). However, if the iliopsoas muscle is affected, aspirates of the muscle may be diagnostic, as shown with Patient 2 (11).

Blood cultures can also be performed, and have been reported to be positive in just over half of human patients (28).

There are risk factors for infectious sacroilitis which can be used to raise clinical suspicion for this condition. In humans, risk factors include pelvic trauma, infectious endocarditis, hemoglobinopathy, immunosuppressive drug treatment, and systemic spread of infections (cutaneous, respiratory, genitourinary) (11). Patient 1 had received radiotherapy, and developed dermatitis and ulcerations at the radiation field. This cutaneous infection could have led to the development of infectious sacroilitis. She was also empirically placed on antibiotic therapy prior to this, which could increase the risk of resistant infections. Patient 2 had a bacterial abscess (as seen in many human patients with infectious sacroilitis) (11), and also had chronic diarrhea, which could have led to a systemic or localized infection. Both dogs were normothermic on presentation. In humans, the frequency of fever with infectious sacroilitis is between 41% and 75% (34). Fever is less common with non-infectious sacroilitis, occurring in about 20% of cases (35). The presence of fever may increase the suspicion for an infectious etiology but, as with the 2 patients in this study, a lack of fever cannot rule it out.

Both of the patients responded to initial antibiotic therapy. Patient 1 received a broad-spectrum antibiotic, due to the previous use of clavaseptin. Patient 2 was treated based on bacterial culture and sensitivity results. Full clinical recovery was achieved in both patients by 6 wk after antibiotics were administered. Antibiotics were discontinued between 4 and 6 weeks after onset of signs, with no relapse in lameness after discontinuation. If no bacterial culture is available, targeting Staphylococcus first is recommended in the human literature, increasing the spectrum to include Gram-negative bacilli if no improvement is seen with initial therapy (11,28). Duration of treatment is varied but suggested to be 6 to 12 wk (11,36,37). Most humans recover clinically, with 1 study showing 37/39 patients responding well under prolonged antibiotic therapy, with a mean duration of 12 wk, but as quickly as 2 wk (11).

Limitations of this retrospective study are that there were only 2 patients and only 1 had bacterial cultures done. Furthermore, in both cases recovery was based on clinical response, and no follow-up imaging was acquired.

In conclusion, infectious sacroilitis is a rare but important differential diagnosis for canine lumbar pain. Imaging characteristics are similar to those seen in human medicine. Characteristic signs include a widened and irregular joint space, contrast enhancement of the articular structures, increased joint fluid, bone marrow edema, periarticular soft tissue edema and contrast enhancement. Radiographs and CT scans can detect chronic structural changes; however, similar to discospondylitis, MRI is the gold standard modality, as it offers the highest sensitivity and specificity for acute inflammatory changes. Characteristic signs associated with infectious sacroilitis, as opposed to the non-infectious etiology, were observed. Bacterial culture is the gold standard for diagnosis, and can be obtained if there is a communicating abscess or affected surrounding musculature. Treatment is relatively straightforward, with good outcomes in the human literature and in the 2 canine patients presented in this study.
References

Comparison of the glucose and insulin responses of horses to 2 formulations of corn syrup

Kira Moser, Heidi Banse

Abstract — The objectives of this study were to compare the insulin and glucose responses of horses to 2 formulations of corn syrup, [Karo Light (Karo) available in the United States, and Crown Lily White (Crown), available in Canada]. Horses were evaluated under both fed ($n = 14$) and fasted ($n = 10$) conditions. Using a randomized crossover design, each horse underwent an oral sugar test using Karo or Crown syrup. There were no significant differences in insulin or glucose time of maximum concentration ($T_{\text{max}}$), maximum concentration ($C_{\text{max}}$), or area under the curve (AUC) or in insulin or glucose concentrations at individual timepoints during fed or fasted conditions. Bland-Altman analysis of insulin at 75 minutes indicated a mean bias of 28.7 pmol/L, with 95% limits of agreement from $-83.9$ to $140.6$ pmol/L (fed) and a mean bias of $11.5$ pmol/L, with 95% limits of agreement from $-78.9$ to $101.9$ pmol/L (fasted). These findings suggest that Karo and Crown syrup produce similar glucose and insulin responses in horses.

Résumé — Comparaison des réponses au glucose et à l’insuline chez les chevaux pour deux formulations de sirop de maïs. Les objectifs de cette étude consistaient à comparer les réponses à l’insuline et au glucose de chevaux pour deux formulations de sirop de maïs, [Karo Light (Karo), disponible aux États-Unis, et Crown Lily White (Crown), disponible au Canada]. Les chevaux ont été évalués dans des conditions non à jeun ($n = 14$) et à jeun ($n = 10$). Chaque cheval a subi un test au glucose oral avec du sirop Karo ou Crown en utilisant une conception croisée sur échantillon aléatoire. Il n’y avait pas de différence significative quant au temps de la concentration maximale de l’insuline ou du glucose ($T_{\text{max}}$), de la concentration maximale ($C_{\text{max}}$) ou de la surface sous la courbe (AUC) ou des concentrations d’insuline ou de glucose à des moments individuels durant les conditions non à jeun ou à jeun. Une analyse Bland-Altman de l’insuline à 75 minutes a indiqué un écart moyen de 28,7 pmol/L, avec 95% de limites de concordance de $-83,9$ à $140,6$ pmol/L (nourris) et un écart moyen de $11,5$ pmol/L, avec 95% de limites de concordance de $-78,9$ à $101,9$ pmol/L (à jeun). Ces résultats suggèrent que les sirops Karo et Crown produisent des réponses semblables au glucose et à l’insuline chez les chevaux.

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Introduction

Insulin dysregulation in horses is characterized by hyperinsulinemia, excessive response to oral carbohydrates, and/or tissue insulin resistance (1,2), and is broadly associated with an increased risk for laminitis (3–5). A diagnostic test for insulin dysregulation is a valuable tool to identify horses at risk for endocrinopathic laminitis, in order to allow for implementation of management strategies to reduce risk. Multiple tests have been developed for the diagnosis of insulin resistance in horses, including the frequently sampled intravenous glucose tolerance test (FSIGTT), the euglycemic hyperinsulinemic clamp (EHC), the combined glucose-insulin tolerance test (CGIT), and the insulin tolerance test (6–9). However, many of these tests are expensive and/or impractical outside of a hospital or research setting. Furthermore, by design, these tests do not include assessment of the intestinal tract in insulin regulation, and a growing body of literature supports the role of incretin hormones and intestinal nutrient absorption in development of insulin dysregulation (10–12). An oral sugar test (OST) is a more recently developed, practical field test for diagnosis of insulin dysregulation in horses (13) that includes evaluation of the entero-insular axis. Therefore, the OST may be useful in the early identification of horses with an excessive response to oral sugar, which may more closely reflect the clinical situation of pasture-associated laminitis than tissue insulin resistance alone (10,14).
The OST was developed using Karo Light (Karo) (ACH Food companies, Memphis, Tennessee, USA) corn syrup and most data on the OST in horses have used this corn syrup formulation (13,15–18). However, Karo syrup is not commercially available in Canada (or other countries), and it is unclear whether any available corn syrups have an equivalent carbohydrate composition. Differences in carbohydrate composition between the 2 formulations could impact insulin responses and thus interpretation of the OST. Therefore, a comparison of the OST using the standard Karo corn syrup versus an available Canadian formulation is warranted, to determine whether each formulation results in a similar insulin response in horses. The purpose of this study was to compare the insulin and glucose responses of horses to 2 formulations of corn syrup, Karo Light and Crown Lily White (ACH Food companies, Memphis, Tennessee, USA), a formulation available in Canada. Since fasting is not always feasible during field testing, horses were tested under both fed and fasted conditions.

**Materials and methods**

**Experiment I**

This study was approved by the University of Calgary’s Veterinary Sciences Animal Care Committee (AC 17-0081). Fourteen seemingly healthy adult horses were included. Nine horses were sourced from a veterinary school teaching herd and 5 were recruited from clients of the University of Calgary’s Distributed Veterinary Teaching Hospital after informed client consent was obtained. Two obese horses had a history of laminitis. Signalment and morphometric data are presented in Table 1. Owners were instructed to maintain horses on a consistent diet for the duration of the study. Horses were either tied or kept in a gravel paddock for the duration of each OST. Horses were not fasted, but feed was removed for the duration of the OST. Data collection was performed in May.

**Experiment II**

Ten horses were included, all sourced from a veterinary school teaching herd. Signalment and morphometric data are presented in Table 1. No horses had a history of laminitis. Horses were kept on pasture for 1 mo before the study and during the washout period. All horses were fasted overnight before the OST. Horses were brought into gravel paddocks and fed 3 flakes of compressed timothy hay at 4 pm the night before each OST. Data collection was performed in July.

**Study design**

An oral sugar test (OST) was performed on each horse randomly assigned to receive 0.15 mL/kg body weight (BW) of either Karo Light corn syrup (ACH Food Companies) or Crown Lily White corn syrup (ACH Food Companies) syringed by mouth. After a 1-week washout period, the OST was repeated and the other corn syrup formulation was administered. Horses were weighed on the morning of each OST using either an electronic scale (Ezi-Weigh; Mettler-Toledo, Columbus, Ohio, USA) or a mobile equine scale (Tokyo, Horse Weigh; Llandrindod Wells, Powys, UK). A 14-gauge catheter (Angiocath; BD Medical, Sandy, Utah, USA) was placed aseptically into the jugular vein of each horse at least 1 h before obtaining the baseline blood sample. Blood was collected from the jugular catheter at baseline, and at 30, 60, 75, 90, and 120 min post-syrup administration into blood tubes with no anti-coagulant for glucose and insulin analyses. Blood glucose was measured within 2 min of collection using a previously validated handheld glucometer (19) (AlphaTrak; Zoetis, Parsippany, New Jersey, USA). Due to high ambient environmental temperatures (up to 30°C), samples were kept on ice until centrifugation within 2.5 h of collection. Whole blood was allowed to warm to room temperature (~30 min) before centrifuging at 1500 × g for 15 min, serum was stored at −80°C until analysis. Serum was analyzed for insulin concentration via radioimmunoassay (Millipore; Temecula, California, USA) at the Animal Health Laboratory, Guelph, Ontario. All samples were analyzed within 2 mo of collection.

**Statistical analysis**

Data were analyzed for normality using a Kolmogorov-Smirnov test. Coefficient of variation was calculated for insulin concentrations. As coefficient of variation was not normally distributed for insulin concentrations in the sampled population, median and interquartile range are reported. Insulin concentrations were log-transformed to achieve normality for assessment of changes over time. Glucose and insulin concentrations over time were compared between formulations using a 2-way analysis of variance (ANOVA) with repeated measures. A Bonferroni post hoc test was used to identify any differences between formulations at individual timepoints. A paired t-test was used to compare variables that were normally distributed (glucose

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Experiment I (fed)</th>
<th>Experiment II (fasted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n = 14)</td>
<td>(n = 10)</td>
<td></td>
</tr>
<tr>
<td>Breed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TB (n = 6)</td>
<td>TB (n = 6)</td>
<td></td>
</tr>
<tr>
<td>QH (n = 6)</td>
<td>QH (n = 3)</td>
<td></td>
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<tr>
<td>WB (n = 1)</td>
<td>SB (n = 1)</td>
<td></td>
</tr>
<tr>
<td>Paint/Appaloosa (n = 1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
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<tr>
<td>8 M</td>
<td>8 M</td>
<td></td>
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<tr>
<td>6 G</td>
<td>2 G</td>
<td></td>
</tr>
<tr>
<td>Age (mean ± SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 ± 7 y</td>
<td>18 ± 3 y</td>
<td></td>
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<tr>
<td>Weight (mean ± SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>525 ± 66 kg</td>
<td>500 ± 48 kg</td>
<td></td>
</tr>
<tr>
<td>Girth:height (mean ± SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2 ± 0.06</td>
<td>1.2 ± 0.04</td>
<td></td>
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<tr>
<td>Neckheight (mean ± SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.6 ± 0.05</td>
<td>0.6 ± 0.04</td>
<td></td>
</tr>
<tr>
<td>Neck circumference (mean ± SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>95.8 ± 6.6 cm</td>
<td>92.8 ± 6.3 cm</td>
<td></td>
</tr>
<tr>
<td>(0.50)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neck height (mean ± SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.1 ± 1.9 cm</td>
<td>11.4 ± 1.7 cm</td>
<td></td>
</tr>
<tr>
<td>Body condition score (median, IQR)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.3 (range: 4 to 7)</td>
<td>5 (range: 4 to 5.5)</td>
<td></td>
</tr>
<tr>
<td>Cresty neck score (median, IQR)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 (range: 1 to 2.25)</td>
<td>1 (range: 1 to 2)</td>
<td></td>
</tr>
</tbody>
</table>

TB — Thoroughbred; QH — Quarter horse; WB — Warmblood; SB — Standardbred; SD — Standard deviation; IQR — Interquartile range; M — Male; G — Gelding.
area under the curve (AUC), maximum concentration of glucose (C_{max}) and a Wilcoxon signed-rank test was used to compare variables that were not normally distributed [insulin AUC, time of maximum concentration (T_{max}) for glucose and insulin, and insulin C_{max}]. Differences between insulin concentrations at T60 and T75 were normally distributed, so Bland-Altman analysis was used to determine agreement between formulations in insulin concentrations at 60 and 75 min.

Results

Insulin immunoassay
The samples were measured using 4 kits. The high and low controls were from the same lot number across the study and were measured in duplicate. Mean concentration of the high control was 356 pmol/L (inter-assay CV, 5.9%; intra-assay CV, 4.7% ± 2.8%) and mean concentration of the low control was 122 pmol/L (inter-assay CV 9.3%; intra-assay CV of 5.8% ± 9.1%). Sample intra-assay CV was not normally distributed. Median intra-assay CV of all samples was 4.9% (interquartile range: 2.45% to 8.7%).

Experiment I
One horse had a missing insulin T30 timepoint in 1 OST, so was excluded from insulin AUC, C_{max}, and T_{max} analyses. Five of 14 horses had changes in management (access to pasture) within 24 to 48 h before the second oral sugar test. Based upon currently recommended insulin cutoff values for insulin dysregulation (20), 1 horse in Experiment I was considered insulin dysregulated with both formulations of corn syrup. All other horses were considered insulin regulated using both formulations of corn syrup. Individual insulin responses over time following oral sugar administration are presented in Figure 1. When evaluating insulin concentrations, there was an effect of time (P < 0.0001) but not treatment (i.e., formulation; P = 0.46), and there was no time by treatment interaction (P = 0.42). Furthermore, there were no differences between formulations in insulin concentrations at individual timepoints (P > 0.99). There were also no differences between formulations in insulin or glucose AUC, T_{max}, or C_{max} (Table 2). When evaluating insulin concentrations at 60 min, Bland-Altman analysis indicated a mean bias of −30 pmol/L, with 95% limits of agreement from −95.7 to 35.7 pmol/L. When evaluating insulin concentrations at 75 min, Bland-Altman analysis indicated a mean bias of 28.7 pmol/L, with 95% limits of agreement from −83.9 to 140.6 pmol/L (Figure 3).

As it is possible that acute dietary change may have contributed to variation among horses in Experiment I, thus increasing the likelihood of a type II error, data were also evaluated with the 5 horses with diet changes excluded. When removing the variability that may be attributable to acute dietary change, there was an effect of time (P < 0.0001) but not treatment (i.e., formulation; P = 0.49) on insulin concentrations, and there was no time by treatment interaction (P = 0.91). There were no differences in insulin concentrations between formulations at any timepoint (P > 0.99). When evaluating glucose concentrations,
There were no differences in insulin or glucose T\textsubscript{max}, C\textsubscript{max}, or P\textsubscript{d}ifferences between formulations at any timepoint (\(P = 0.08\)). The results of this study suggest that Crown and Karo syrups provide similar glucose and insulin responses in horses when used in an OST, whether horses are in a fed or fasted state.

The OST using Karo syrup makes the test in its current form impractical in other countries. In this study, we compared the insulin and glucose responses of horses in an OST using Karo Light (ACH Food Companies) corn syrup and a Canadian formulation of corn syrup, Crown Lily White (ACH Food Companies) corn syrup. As this test is often performed in the field, and housing may preclude complete fasting, horses were evaluated following oral sugar administration in experiments I (fed) and II (fasted).

Table 2. Area under the curve (AUC), C\textsubscript{max}, and T\textsubscript{max} of insulin and glucose responses to corn syrup administration in experiments I (fed) and II (fasted).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Experiment I (fed) ((n = 14))</th>
<th>Experiment II (fasted) ((n = 10))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karo insulin AUC (pmol/L/min) (median, IQR)</td>
<td>15 908 (10 965 to 24 840)</td>
<td>14 442 (10 112 to 17 753)</td>
</tr>
<tr>
<td>Crown insulin AUC (pmol/L/min) (median, IQR)</td>
<td>15 360 (9 563 to 21 432)</td>
<td>14 194 (13 001 to 17 396)</td>
</tr>
<tr>
<td>Karo insulin C\textsubscript{max} (pmol/L) (median, IQR)</td>
<td>173 (125.5 to 253.5)</td>
<td>154 (137.5 to 211.5)</td>
</tr>
<tr>
<td>Crown insulin C\textsubscript{max} (pmol/L) (median, IQR)</td>
<td>172 (115.5 to 234.5)</td>
<td>157 (122.8 to 191.5)</td>
</tr>
<tr>
<td>Karo insulin T\textsubscript{max} (min) (median, IQR)</td>
<td>60 (30 to 60)</td>
<td>60 (52.5 to 97.5)</td>
</tr>
<tr>
<td>Crown insulin T\textsubscript{max} (min) (median, IQR)</td>
<td>60 (52.5 to 67.5)</td>
<td>60 (30 to 63.75)</td>
</tr>
<tr>
<td>Karo glucose AUC (mmol/L) (mean ± SD)</td>
<td>800.5 +/- 133.8</td>
<td>777.9 +/- 91.2</td>
</tr>
<tr>
<td>Crown glucose AUC (mmol/L) (mean ± SD)</td>
<td>805.7 +/- 115.8</td>
<td>804.9 +/- 34.83</td>
</tr>
<tr>
<td>Karo glucose C\textsubscript{max} (mmol/L) (mean ± SD)</td>
<td>7.6 +/- 1.5</td>
<td>7.2 +/- 0.9</td>
</tr>
<tr>
<td>Crown glucose C\textsubscript{max} (mmol/L) (mean ± SD)</td>
<td>7.7 +/- 1.1</td>
<td>7.6 +/- 0.4</td>
</tr>
<tr>
<td>Karo glucose T\textsubscript{max} (min) (median, IQR)</td>
<td>60 (30 to 67.5)</td>
<td>60 (60 to 86.25)</td>
</tr>
<tr>
<td>Crown glucose T\textsubscript{max} (min) (median, IQR)</td>
<td>60 (45 to 67.5)</td>
<td>60 (30 to 60)</td>
</tr>
</tbody>
</table>

\(T\text{\textsubscript{max}}\) — time of maximum concentration; \(C\text{\textsubscript{max}}\) — maximum concentration.

\(SD\) — standard deviation; \(IQR\) — interquartile range.

There was an effect of time (\(P < 0.0001\)) but not treatment (\(P = 0.78\)) and no time by treatment interaction (\(P > 0.99\)) or differences between formulations on glucose concentrations at individual timepoints (\(P > 0.09\)). There was an effect of time (\(P < 0.0001\)) but not treatment (\(P = 0.51\)) and no time by treatment interaction (\(P = 0.09\)) on glucose concentrations or differences in formulations on glucose concentrations at individual timepoints (\(P > 0.4\)), or on insulin or glucose AUC, \(T\text{\textsubscript{max}}\), or \(C\text{\textsubscript{max}}\) (\(P > 0.26\)). For insulin concentrations at 60 min, Bland-Altman analysis indicated a mean bias of 11.5 pmol/L, with 95% limits of agreement from -103.7 to 182.1 pmol/L. For insulin concentrations at 75 min, Bland-Altman analysis indicated a mean bias of 11.5 pmol/L, with 95% limits of agreement from -78.9 to 101.9 pmol/L (Figure 6).

**Discussion**

The OST using Karo syrup provides a practical and cost-effective method of assessing insulin regulation in horses in the United States. However, the limited global availability of Karo corn syrup makes the test in its current form impractical in other countries. In this study, we compared the insulin and glucose responses of horses in an OST using Karo Light (ACH Food Companies) corn syrup and a Canadian formulation of corn syrup, Crown Lily White (ACH Food Companies) corn syrup. As this test is often performed in the field, and housing may preclude complete fasting, horses were evaluated following oral sugar administration in both a fed and a fasted state.

The results of this study suggest that Crown and Karo syrups produce similar glucose and insulin responses in horses when used in an OST, whether horses are in a fed or fasted state.

The OST using Karo syrup has good repeatability when used in an OST, whether horses are in a fed or fasted state.
insulin dysregulated) (16,17). However, based upon the Equine Endocrinology Group cut-off guidelines (20), only 2 horses in the present study were diagnosed as insulin dysregulated, including 1 horse that had an insulin outside cut-off guidelines at T30. Since there was only 1 insulin dysregulated horse in each experiment, evaluating repeatability of the OST using a binary interpretation (insulin dysregulated or not) was of limited value, so agreement between the 2 formulations was evaluated based upon a single timepoint (either 60 or 75 min). In addition, differences in insulin concentrations at each individual timepoint were assessed. The 95% limits of agreement in insulin concentrations between formulations at T60 or T75 in both fed and fasted horses were similar to those found by Frank and Walsh (17) in horses when repeatability was assessed using the same syrup formulation (Karo Light). Furthermore, there were no significant differences between formulations in insulin concentrations at any timepoint, whether horses were fed or fasted. Taken together, these findings suggest that the differences observed between Karo and Crown corn syrup formulations are similar to the differences observed in repeatability studies using Karo Light corn syrup in horses.

In this study, a wide range in insulin \( T_{\text{max}} \) between horses was observed with both formulations, from 30 min to 120 min. This variability presents a challenge in interpreting the OST with a single blood sample. This is in agreement with other studies which have found a difference in insulin \( T_{\text{max}} \) between ponies and horses, and between horses of different body conditions (21–23). Knowles et al (16) found that test agreement improved when 2 samples were taken 30 min apart, rather than at a single timepoint. Thus, perhaps 2 blood samples would improve the sensitivity of the test and increase the probability of obtaining a sample at the \( C_{\text{max}} \) (24). Insulin AUC has been demonstrated to be more repeatable than a single timepoint (15,16). However, this measured outcome would increase the cost and time involved to perform the test, making it a less practical field option. Additionally, it is unclear which measured outcome (insulin AUC, \( C_{\text{max}} \), or another) is most associated with the risk of developing laminitis. In 1 study, both AUC and insulin at 60 min differentiated between previously laminic and non-laminic ponies (15).
Experiment I of the study included 2 horses with BCS of 8/9 and a history of laminitis, thus were highly suspected of being insulin dysregulated. However, they were not diagnosed as insulin dysregulated using either formulation of syrup based on cut-offs recommended by the Equine Endocrinology Group (20). The lack of fasting before the OST in these horses may have altered their insulin response to the OST. The OST was developed under fasted conditions (13), and feeding may decrease the degree of insulin response observed following oral sugar administration (15,25). Furthermore, corn syrup dose or insulin cut-off values may not have been appropriate for diagnosis of insulin dysregulation in those horses. Initially, an insulin concentration >430 pmol/L using a Coat-A-Count radioimmunoassay (RIA) was proposed as diagnostic for insulin dysregulation at 60 to 90 min post-OST (26). However, initial evaluation of the OST was performed comparing lean, healthy horses to horses with severe insulin dysregulation (most had fasting hyperinsulinemia), suggesting that those horses may have had more severe disease (13). More recently, the Equine Endocrinology Group has proposed an insulin concentration of >323 pmol/L to be consistent with insulin dysregulation (20). A recent study in a small cohort of ponies suggested that a higher dose of Karo syrup (0.45 mL/kg BW) was better at predicting laminitis than a 0.15 or 0.3 mL/kg BW dose (15), and a cut-off value of 790 pmol/L at 60 min could differentiate previously laminitic from non-laminitic ponies. Although these studies did not all use the same method for insulin measurement, which may influence absolute cut-off values, when taken together, these findings suggest that a lower insulin cut-off value at the 0.15 mL/kg BW dose, or a higher dose of corn syrup, may improve sensitivity of the test for diagnosis of insulin dysregulation. Further investigation of insulin response to the oral sugar test in a larger population of horses with and without laminitis may allow for establishment of appropriate cut-off values.

Label claims suggest that the sugar content of Karo and Crown corn syrups may differ. Karo syrup contains 5 g of sugar per 15 mL, whereas Crown contains 6 g per 15 mL. High performance liquid chromatography has demonstrated that the Karo syrup has 356.3 mg/mL of digestible (i.e., dextrose and maltose) sugars (15). The composition of digestible sugars in Crown syrup is not known, and there may be other sugars present in corn syrup, including inulin and fructose, that lead to differences in insulin response (21,27). However, the expense of high-performance liquid chromatography precluded analysis by this method herein. Furthermore, since horses appeared to have similar insulin and glucose responses to both corn syrup formulations, differences in sugar content may not have been substantial enough to influence results.

Many factors affect insulin response to oral glucose in horses, including diet, age, and breed (28–31). Limitations for the present study include a heterogeneous population of horses (i.e., different breeds, ages, and body conditions) and lack of a controlled diet. Despite directions to barn managers and owners to maintain the same management for horses throughout the study period, in Experiment I, 5 out of 14 horses were inadvertently turned out to pasture during the washout period for 24 to 48 h, which resulted in an acute diet change from hay to pasture. This may have induced variation in the insulin responses of these horses when the repeat OST was performed. Changes in carbohydrate content of the diet can affect expression of glucose transporters, and it has been shown that horses on high carbohydrate diets become less insulin sensitive (29,32,33). Since pasture generally has a higher non-structural carbohydrate (NSC) content than hay, ingestion of pasture may have affected insulin responses. However, no significant differences were apparent between formulations, either with or without these horses included in analysis. In Experiment II, horses were maintained on the same pasture for the duration of the washout period; however, NSC content of pasture can vary with temperature, moisture, as well as diurnally, and this variation has been shown to affect OST results (18,27,34). Thus, variation in NSC content of the pasture over the 6-day washout period may have affected insulin responses in our horses and resulted in some of the individual variation observed in response to the 2 corn syrup formulations. Duration of fasting may also have varied between horses, since they were fed at 4 pm and not monitored for consumption of their feed. However, differences among insulin responses to the OST were not observed in horses when fasting duration was 3, 6, or 12 h (25); thus, a difference in fasting duration was unlikely to have had a substantial influence on our results.

The preliminary work presented here suggests similar insulin and glucose responses are observed in horses whether using Karo or Crown syrup. Furthermore, the variability seen between formulations is similar to the variability seen in repeatability studies using the same formulation of corn syrup. These findings support the use of similar reference ranges for Crown syrup. However, due to the low number of horses diagnosed with insulin dysregulation in this study, no conclusions can be made on agreement between formulations for diagnosing insulin dysregulated horses. Further investigation into agreement between formulations in insulin dysregulated horses is warranted.

Acknowledgment

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References


Determinants of pet food purchasing decisions

Molly Schleicher, Sean B. Cash, Lisa M. Freeman

Abstract — The objective of this study was to identify determinants of pet food purchasing decisions. An online survey was administered via e-mail, newsletters, and social media. A total of 2181 pet owners completed the survey: 1209 dog owners and 972 cat owners; 26% of respondents were animal professionals. Pet food characteristics ranked the highest were health and nutrition, quality, ingredients, and freshness. The veterinary healthcare team was reported to be the primary (43.6%) and most important source of nutrition information for pet owners; Internet sources were the primary information source for 24.6% of respondents. Most pet owners reported giving equal (53.1%) or more priority (43.6%) to buying healthy food for their pets compared with themselves. Results suggest that pet owners face numerous challenges in determining the best diet to feed their pets.

Résumé — Déterminants des décisions d’achat des aliments pour animaux de compagnie. Cette étude avait pour objectif d’identifier les déterminants des décisions d’achat des aliments pour animaux de compagnie. Un sondage en ligne a été administré par l’entremise de courriels, de bulletins et des médias sociaux. Un total de 2181 propriétaires d’animaux a répondu au sondage: 1209 propriétaires de chiens et 972 propriétaires de chats; 26 % des répondants étaient des professionnels pour animaux. Les caractéristiques des aliments pour animaux qui étaient les plus importantes étaient la santé et la nutrition, la qualité, les ingrédients et la fraîcheur. L’équipe de soins vétérinaires a été mentionnée comme la source primaire (43,6 %) et la plus importante d’information pour les propriétaires d’animaux. Les sources sur Internet représentaient la source primaire pour 24,6 % des répondants. La plupart des propriétaires d’animaux ont signalé qu’ils accordaient une priorité égale (53,1 %) ou une plus grande priorité (43,6 %) à l’achat d’aliments sains pour leurs animaux de compagnie comparativement à eux-mêmes. Les résultats suggèrent que les propriétaires sont confrontés à plusieurs défis en vue de déterminer la meilleure diète pour leurs animaux de compagnie.

Introduction

Pet ownership in the United States has been steadily growing, with 68% of households having at least 1 pet in 2014 (1). Consumer spending on pets has also risen dramatically from $17 billion in 1994 to $58 billion in 2014 (1). A substantial component of this spending has been for pet food, with US consumers having spent an average of $194 per year in 2013 for pet food (2). Concurrently, the pet food industry has expanded to include new retail outlets for pet food, new marketing strategies, and new varieties of pet food. Also, the growing trend of humanization and anthropomorphism of pets has spurred strong marketing messages, ingredient claims, and confusing and often conflicting information on the Internet about the best food for pets (1–3). These factors have made it increasingly difficult for pet owners to make objective pet food purchase decisions. One survey of 900 dog owners found that nearly half responded that choosing the right food for their dog was the most difficult part of pet ownership. In this same survey 52% of dog owners [and 68% of Millennial (ages: 18 to 34) dog owners] responded that their dogs’ nutrition was more confusing than their own, with nearly 25% feeling overwhelmed with the choices available (3).

Several studies have revealed that food characteristics, food recommendation sources, and the relationship between pet and owner seems to be the major factors influencing food purchase decisions (3–10). Food characteristics such as price, ingredients, and quality have been identified by several studies as important considerations for pet food purchasers. Ingredients have been identified in multiple studies as the most important factor for most pet owners when selecting a food for their pets (4,8). It appears that consumers prefer lower priced pet food, but value natural and organic ingredients (8). While most pet owners feed commercial pet food to their pets, many feed their pets other foods, such as home-prepared foods, table scraps, and raw meat-based diets. This may be in part due to an apparently growing perception that commercial pet foods may not be wholesome.
nutritious, and safe, and that other sources of food may be more natural and more nutritious (6). Recommendations for pet food also appear to be important, with research consistently showing that veterinarians are the most common source of information for consumers regarding pet nutrition (6). However, the Internet and social media have become increasingly common sources of pet nutrition information (and misinformation) in recent years (11).

The relationship between a consumer and pet also appears to be an important factor in pet food purchase behavior. A growing trend of anthropomorphism of pets by their owners may also have an impact on pet food selection and purchase (5,12,13). Research has shown that pet owners with the highest anthropomorphism scores placed the most importance on health/nutrition, quality, freshness, and taste of pet food, and also valued taste and variety in their pets’ diets (4). With the humanization of pets, trends in human food and nutrition often spill over into the pet food industry. Some studies have examined whether similarities exist between consumer behavior for themselves and their pets (5,10). One study found that dog owners who are more serious about purchasing healthy food for themselves are more likely to be serious about purchasing healthy food for their dog as well (14). In addition, owners who are price sensitive and loyal to their own food and food brands are also more likely to be price sensitive and loyal to their pets’ food and food brands (5).

The expanding number of pet food options and growing interest among pet owners in feeding their pets the best diets possible have led consumers to struggle to make appropriate pet food purchase decisions (3). Consumers face a dizzying array of pet food choices and a growing wealth of misinformation regarding pet nutrition on the Internet. Understanding how consumers make pet food purchase decisions and what aspects of pet food are most important is essential information for veterinarians to help pet owners make more objective decisions about their pets’ food. The purpose of this study, therefore, was to identify determinants of pet food purchasing decisions.

Materials and methods
A survey was designed to gather information about pet food purchase decisions, including the type of pet owned, factors influencing pet food purchases, owners’ relationship with their pets, and demographics. Survey questions were created based on past consumer behavior research surveys and established scales (4–7,14,15). Most responses were made using a 7-point Likert scale (i.e., 1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, 7 = strongly agree, or 8 = not applicable) or a 5-point Likert scale (i.e., 1 = not at all important, 2 = slightly important, 3 = moderately important, 4 = very important, 5 = extremely important). Pet attachment was assessed by the contemporary version of the Companion Animal Bonding scale (CABS) (15). Scores for the CABS were broken into 3 groups. A high level of bonding was indicated by a CABS score of ≥ 30. An intermediate level of bonding was indicated by a CABS score between 20 and 30 and a low level of bonding was indicated by a CABS score of ≤ 20. The Health Prioritization Gap measure was calculated by subtracting scores of the importance of healthy food for pet ratings from scores of the importance of healthy food for self ratings.

The survey was administered through commercial survey software and was available from July 2015 to February 2016. The survey was designed so that the respondent entered the names of all his or her pets and then the software randomly selected 1 of the respondent’s pets (if they owned more than 1) and asked the questions as they pertained to that specific pet. The survey was designed to take 10 to 15 min to complete. A “snowball” survey recruitment approach was used to invite cat and dog owners to participate in the study. The survey was widely distributed via e-mail; university, veterinary hospital, and pet owner newsletters and e-lists; and social media. Distribution of the electronic survey link was not restricted. Any person who accessed the link was able to provide electronic consent and complete survey questions if they were over the age of 18 and owned a dog or cat at the time of survey distribution. The study was approved by the Tufts University Social Behavioral, and Educational Research Institutional Review Board.

Data were analyzed using Stata 13 statistical software (Stata Corp, College Station, Texas, USA). Data are presented for respondents who completed the survey, which was defined as completing at least 80% of the questions. Descriptive data were reported as actual counts and the percentage of respondents. Associations between variables were assessed using Spearman’s rho correlation (for ordinal measures), and mean scores were compared using t-tests. P-values ≤ 0.05 were considered significant.

Results
Demographics
The online survey was accessed 2484 times with a total of 2181 respondents completing at least 80% of the survey. Fifty-five percent (1209/2181) of respondents answered questions about their dog and 45% (972/2181) of respondents answered questions about their cat. There were no significant differences in demographics for cat and dog owners (data not shown) so these were combined for all results. Respondents were predominately female (1838/1974) and the age of all respondents ranged from 18 to 82 y [mean = 46 y, standard deviation (SD) = 14.6 y]. A notably large proportion (564/1975, 28.6%) of respondents were employed in the veterinary healthcare field or animal industry, including self-identified veterinarians, veterinary technicians, breeders, animal trainers, and/or pet store employees. Most respondents (1981/2181) were the primary decision-makers in pet food purchases (Table 1).

Characteristics of foods purchased
Respondents were asked several questions regarding what types of food they feed their pets and where they purchase pet foods (Table 2). Eighty-nine percent (1943/2188) of respondents indicated that they feed commercially prepared foods to their pets and over half (1194/2182) of respondents indicated that they feed primarily dry food to their pet. The only significant difference between cat and dog owners was that cat owners were significantly more likely to feed canned food than were dog owners (713/977 for cats versus 419/1211 for dogs; P < 0.001).

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Table 1. Demographics of 2181 pet owners who responded to a survey about pet food purchasing decisions.

<table>
<thead>
<tr>
<th>Gender (out of 1976 respondents)</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>1838 (93%)</td>
</tr>
<tr>
<td>Male</td>
<td>136 (7%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Annual household income (1965 respondents)</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0 to $25 000</td>
<td>156 (7.9%)</td>
</tr>
<tr>
<td>$25 000 to $50 000</td>
<td>334 (17.0%)</td>
</tr>
<tr>
<td>$50 000 to $75 000</td>
<td>277 (14.1%)</td>
</tr>
<tr>
<td>$75 000 to $100 000</td>
<td>304 (15.4%)</td>
</tr>
<tr>
<td>&gt; $100 000</td>
<td>514 (26.1%)</td>
</tr>
<tr>
<td>Prefer not to answer</td>
<td>386 (20.0%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Education (1973 respondents)</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12th grade or GED*</td>
<td>104 (5.3%)</td>
</tr>
<tr>
<td>Some college/Associate’s degree</td>
<td>402 (20.4%)</td>
</tr>
<tr>
<td>College</td>
<td>663 (33.6%)</td>
</tr>
<tr>
<td>Non-doctoral graduate degree or professional degree</td>
<td>521 (26.4%)</td>
</tr>
<tr>
<td>Doctoral degree</td>
<td>281 (14.3%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Occupation (1976 respondents)</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veterinarian</td>
<td>167 (8.5%)</td>
</tr>
<tr>
<td>Veterinary technician</td>
<td>158 (8.0%)</td>
</tr>
<tr>
<td>Breeder</td>
<td>70 (3.5%)</td>
</tr>
<tr>
<td>Animal trainer</td>
<td>155 (7.9%)</td>
</tr>
<tr>
<td>Pet store employee</td>
<td>14 (0.7%)</td>
</tr>
<tr>
<td>None of the above</td>
<td>1411 (71.4%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Role in food purchase decisions (2181 respondents)</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary decision-maker</td>
<td>1981 (90.8%)</td>
</tr>
<tr>
<td>Some role</td>
<td>185 (8.5%)</td>
</tr>
<tr>
<td>No role</td>
<td>15 (0.7%)</td>
</tr>
</tbody>
</table>

Thirteen percent (278/2182) of respondents indicated that they fed other types of food to their pet, including raw food, dehydrated food, or supplements. Respondents reported buying their pet food primarily at large specialty stores (26.5%), small “boutique” specialty pet stores (18.5%), veterinarians’ offices (11.91%), and grocery stores (10.9%); other sources included Internet retailers (e.g., Amazon), farmers’ markets, directly from the manufacturer, or from local agricultural feed stores.

Pet dietary or nutrition information sources

The veterinary healthcare team, including veterinarians, veterinary technicians, and veterinary clinic staff, was the primary pet dietary or nutrition information source for most respondents (853/1958; 43.6%) and Internet sources were the primary information source for 24.6% (481/1958; Figure 1). Other sources of information were the primary source for 15.6% (305/1958) of respondents and included animal nutritionists, owner initiated research and a combination of information sources. When asked to rate the importance of recommendations from different information sources on a 5-point Likert scale, veterinarians and the veterinary staff were ranked to be of the highest importance (3.82 ± 0.03 and 3.12 ± 0.03, respectively), whereas Internet sources were ranked as slightly to moderately important (2.63 ± 1.29; Figure 2).

Factors affecting food purchase

Respondents were asked to indicate their agreement with statements about pet food purchases on a 7-point Likert scale. The statements with the strongest agreement related to the importance of providing the pet with the best nutrition possible, buying a pet food that is beneficial for the pet, consistent quality, and feeding a diet that is best for the pet’s medical condition (Table 3). The mean score for being very knowledgeable about how to feed their pets was 6.23 ± 1.02 (agree to strongly agree). The statements with the lowest agreement scores were providing the pet with the best nutrition possible, buy-
respondents were also asked to rate their agreement with 2 statements about pet food labels. For the statement, “Information on pet food labels is misleading,” 63.02% (1256/1993) agreed. For the statement, “Information on pet food labels is easy to understand,” 41.1% (817/1988) agreed and 47.2% (937/1985) did not agree.

The health prioritization gap
Respondents were asked to rate how important buying healthy food was for themselves and how important buying healthy food was for their pet. The owner-pet “Health Prioritization Gap” (i.e., the difference between these separate scores) showed that 1023/1926 (53.1%) of respondents had equal priority for themselves and their pet (Health Prioritization Gap = 0, Equal Priority group). Of the 1926 respondents, 840 (43.6%) had scores indicating a higher importance for buying healthy food for their pet (Higher Priority Pet group), and only 63/1926 respondents (3.3%) had scores indicating a higher priority on buying healthy food for themselves compared to the pet (Higher Priority Self group). The mean age of respondents in the Higher Priority Pet group was slightly but statistically significantly younger (44 y versus 47 y; \(P = 0.0063\)) and this group was significantly more likely to actively seek out information about pet food (as indicated by higher rankings to the question “I actively seek out information about pet food”; \(P < 0.001\)) compared to the Equal Priority group.

Role of price and brand loyalty
To further examine differences in purchase decisions for the pet versus respondents’ own food, respondents were asked how important changes in price were for their food versus their pets’ food on a 5-point Likert scale. Respondents rated changes in the price of their own food as more important (3.36 ± 0.02) than changes in the price of their pets’ food (2.90 ± 0.03; \(P < 0.001\)). There was also a significantly higher score for loyalty to pet food (3.48 ± 0.02) versus owner food (3.22 ± 0.02) brands (\(P < 0.001\)).

Bonding scale
The CABS was used to examine the relationship between pet owners and their pets. Most respondents (1770/2042; 86.7%) had a high level of bonding with their pet, while only 12.9% (263/2042) and 0.4% (9/2042) had intermediate or low levels of bonding, respectively. There was a positive correlation between CABS score and agreement with the statement “I enjoy preparing food for my pet” (\(r = 0.0793, \ P = 0.001\)). There was a negative correlation between CABS and the reported importance of feeding a diet that is low in carbohydrates (\(r = -0.0484, \ P = 0.039\)), but no correlation with other feeding preferences.

Discussion
Most responders to the current survey wanted to feed their pets the best, most nutritious diet possible. Similar to findings from
other studies, the results of this study indicate that pet owners assess the healthfulness, freshness, and ingredients of a pet food when making pet food purchase decisions. However, owners may inaccurately assess how healthy, nutritious, or fresh the pet food or ingredients within a pet food are. While it is encouraging that owners may assess the healthfulness, freshness, and ingredients of a pet food other studies, the results of this study indicate that pet owners may be valuable.

Price was not reported to be a highly important factor in food purchase decisions, with a mean response of 4.81 out of 7 (5 = somewhat agree) on the statement, “I buy a pet food that is reasonably priced.” These findings may be due to respondents being relatively affluent. It is also possible that the question may have been interpreted differently by different respondents and this could have influenced the respondents’ answers. However, respondents rated changes in the price of their own food as more important than changes in the price of their pets’ food, so the lower priority of price for pet food selection could be related to the higher importance of other factors, such as being healthy, nutritious, or containing good ingredients.

The veterinary healthcare team was not only the most commonly reported primary source of nutrition information, but it also was rated as the most important source. This is similar to prior research and identifies an opportunity to proactively provide accurate information to owners on pet nutrition. This underscores the importance of performing a nutritional assessment on every pet at every visit (19,20), which includes assessing body weight, body condition score, muscle condition score, diet, and making a specific nutritional recommendation. Furthermore, it is important that veterinarians receive adequate training and education on nutrition and provide consistent recommendations to pet owners.

Table 3. Agreement with statements regarding pet food purchasing decisions from 2,181 pet owners who responded to a survey about pet food purchasing decisions. The number of respondents for each question is listed in parentheses.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>I want to provide my pet with the best nutrition possible</td>
<td>6.70 ± 0.65</td>
</tr>
<tr>
<td>I buy a pet food that is beneficial to my pet</td>
<td>6.47 ± 0.82</td>
</tr>
<tr>
<td>I buy a pet food that has consistent quality</td>
<td>6.43 ± 0.83</td>
</tr>
<tr>
<td>I feed a diet that is best for my pet’s medical condition, if applicable</td>
<td>6.35 ± 1.00</td>
</tr>
<tr>
<td>I am very knowledgeable about how to feed my pet</td>
<td>6.23 ± 1.02</td>
</tr>
<tr>
<td>I always try to get the best quality for the best price when buying pet food</td>
<td>6.03 ± 1.39</td>
</tr>
<tr>
<td>I actively seek our information about pet food</td>
<td>5.54 ± 1.61</td>
</tr>
<tr>
<td>I trust my veterinarian's advice regarding nutrition for my pet</td>
<td>5.28 ± 1.84</td>
</tr>
<tr>
<td>I notice when pet food products I regularly buy change in price</td>
<td>5.24 ± 1.81</td>
</tr>
<tr>
<td>Information on pet food labels is misleading</td>
<td>4.90 ± 1.55</td>
</tr>
<tr>
<td>I buy pet food that offers value for the money</td>
<td>4.83 ± 1.64</td>
</tr>
<tr>
<td>I buy a pet food that is reasonably priced</td>
<td>4.81 ± 1.61</td>
</tr>
<tr>
<td>I enjoy preparing foods for my pet</td>
<td>4.63 ± 1.81</td>
</tr>
<tr>
<td>Information on pet food labels is easy to understand</td>
<td>3.83 ± 1.73</td>
</tr>
<tr>
<td>My pet's meals need to be planned in advance</td>
<td>3.70 ± 2.00</td>
</tr>
<tr>
<td>I always plan my pet's meals a few days in advance</td>
<td>3.16 ± 2.04</td>
</tr>
<tr>
<td>I change pet food because my pet gets tired of the existing one</td>
<td>2.76 ± 1.77</td>
</tr>
</tbody>
</table>
Other sources of information such as the Internet or owner research were also identified as important primary information sources in the current survey. However, some owners appear to be using unreliable sources to inform their pet food purchase decisions and they may not fully understand how to properly read a pet food label, to objectively select the best food for their pet, or to evaluate results of nutritional research (20). This may result in owners feeding a diet to their pet that is not nutritionally adequate, safe, or appropriate for their pet’s life stage or medical conditions. Results of this study also revealed that while most respondents trust their veterinarians’ advice, respondents scored their own knowledge about pet nutrition highly and some responded that they did not trust their veterinarians’ advice on pet nutrition. A previous study reported significant differences between owners feeding commercial foods versus owners feeding noncommercial foods in statements indicating mistrust of pet foods, pet food manufacturers, and veterinarians (7).

The current survey revealed that while most pet owners are aware of calorie labeling on pet food, they may not be aware of how to find and properly use this information. Responses in this survey support the clinical impression that information on pet food labels is misleading and is not easy to understand. This finding is supported by prior research showing that over 70% of respondents believed that pet food labels do not list all the ingredients, although pet food labels are required by the Association of American Feed Control Officials (AAFCO) to list all ingredients (21). Furthermore, consumers may be misinformed about the meaning of certain terms (such as “by-products”) or information on the label (such as whether the food is complete and balanced or if it has undergone feeding trials) (22,23). This confusion around pet food labels is like the confusion and lack of understanding of consumers’ own food labels.

The veterinary healthcare team should take this into account when counseling owners on nutrition. It is important to ensure that the entire veterinary healthcare team is well-educated in evidence-based pet nutrition and that they take the necessary time to educate owners on how to properly understand and use information on pet food labels.

Much of the prior research in consumer behavior with regard to pet food has focused on dog owners. In this study, both cat and dog owners were enrolled, allowing for the comparison of food purchase behavior between dog and cat owners. Overall, no significant differences were found between responses of cat and dog owners, other than a higher proportion of cat owners reporting that they feed canned food. Given this finding, it appears that similar strategies can be employed when counseling cat owners, dog owners, or owners of both cats and dogs on how to best feed their pets.

Limitations of this study include the primarily female, well-educated, and affluent sample that may not represent the larger pet owner population. In addition, employees of the veterinary and animal fields represented approximately 26% of the sample and could represent a biased population. On average, the animal professionals in our sample were younger and better educated than other respondents; were less likely to report that they enjoyed preparing their own food; and illustrated some significant differences in where they purchased food and in the information sources they utilized. Interestingly, the animal professionals did not exhibit significantly different preferences for the labeled attributes of food (such as natural, organic, low-carb, GMO-free) than other respondents, nor did they score significantly different on the companion animal bonding scale.

**Figure 3.** Importance of pet food characteristics for 2181 pet owners responding to a survey. Bars indicate the mean score reported for each source, where: 1 = not at all important, 2 = slightly important, 3 = moderately important, 4 = very important, and 5 = extremely important.
Furthermore, respondents were recruited for this study primarily by receiving a link to the survey either via e-mail or social media blasts from the veterinary hospital, or through a friend referral. Therefore, the sample may not be generalizable to the greater population of pet owners, particularly as the distribution of the sample in online pet owner communities may attract respondents for whom pet ownership is a stronger part of their self-identity than is the case for the general population of pet owners. Finally, as a survey study, we rely on self-reported behaviors and thus results may not completely reflect how respondents would actually act in a given food purchase situation. In addition, the use of survey questions with predetermined answer scaled may result in varying interpretations or limited answers. Revealed preference measures obtained through observational studies, purchases experiments, or purchase scan data would be useful to investigate whether these self-reports are accurate representations of actual consumer behavior.

In conclusion, ensuring that pets receive proper nutrition requires understanding of consumer behavior in regard to pet food purchase decisions. Increasing marketing claims and misinformation about pet nutrition and the spillover of trends from the human health and nutrition realm into the pet food market complicate the challenging task of educating consumers on how to best feed their pets. However, the strong bond owners have with their pets, their priority for providing their pets with the best nutrition possible, and their use of the veterinary healthcare team for nutritional information provide an excellent opportunity. In order to provide sound nutritional advice to their clients, members of the veterinary healthcare team need to understand the underlying motivations of pet food purchases and why a pet is being fed a certain diet. This information should then be used to provide specific evidence-based recommendations that optimize patients’ health.

References
Richter’s hernia in a 3-month-old colt — A rare event

Amanda Avison

Abstract — Umbilical hernias are among the most common congenital defects in horses. Complications of umbilical hernias are uncommon, and Richter’s hernias are rare. This report describes a case of Richter’s hernia in a 3-month-old colt that was presented with signs of acute colic. The foal underwent a herniorrhaphy with intestinal resection and anastomosis.

Discussion

Next to cryptorchidism, umbilical herniation is the most common congenital disorder of horses examined at veterinary referral hospitals in North America (1). Many small (≤ 3 cm)
umbilical hernias in horses often resolve spontaneously by 1 y of age (2) and are therefore not treated. A 1996 study reported that horses with umbilical hernias constituted 0.84% of the equine hospital population (3). This number likely underestimates the actual occurrence due to those that resolve spontaneously or are treated on-farm. The actual prevalence of umbilical hernias is likely closer to that reported in a study of foals not examined at a hospital, in which 29.5% (13/44) were found to have umbilical hernias at 8 wk of age (4).

Complications of umbilical hernias in horses occur infrequently. These complications include bowel incarceration and/or strangulation, parietal herniation, abscession and formation of enterocutaneous fistulae, and occurred in 8.8% (13/148) of cases in 1 study (5). This percentage only includes records of horses admitted to a referral hospital, and since many hernias resolve spontaneously without complication, the complication rate is < 8.8%. This case, therefore, was a rare occurrence of a Richter's hernia, with a reported prevalence of 0.7% (1/148) of horses presented to referral hospitals (5). Richter's hernias, in which only the antimesenteric intestinal wall is strangulated, have typically been associated with enterocutaneous fistulae (6). Fistulae occur due to necrosis of the entrapped antimesenteric border and hernia sac, allowing leakage of intestinal contents (6). It is unknown whether this case would have progressed to fistula formation if surgical correction had been delayed.

There are several options described for the treatment of umbilical hernias in horses. Surgical correction (herniorrhaphy) is the only option for non-reducible or complicated hernias. An advantage of surgical intervention is that the hernia contents can be evaluated. Unfortunately, it is generally more expensive than other corrective approaches, and requires general anesthesia which creates a significant risk. One report of outcomes of umbilical herniation found that surgical correction before incarceration shortened the surgery time by a mean of 40 min (3). All owners surveyed reported satisfaction with the outcome of surgical correction (3).

There are several alternatives to herniorrhaphy for uncomplicated umbilical hernias. Abdominal bandages, although commonly used in calves, do not appear to be as effective in foals due to the shape of their abdomen and difficulty keeping the bandage from slipping caudally (7).

An umbilical clamp can be used to prevent ongoing herniation of abdominal contents while stimulating inflammation of the body wall in order to close the defect. It is recommended that the clamp only be applied while the foal is in dorsal recumbency to ensure that abdominal contents are not accidently entrapped in the clamp (3). Reported complications with the umbilical clamp are sloughing of the hernia sac before body wall closure and visceral damage if the clamp is placed without complete reduction of contents (2). Riley et al (3) found that 94% (29/31) of owners surveyed were satisfied with the outcome of umbilical clamping. Reported complications were premature dislodgement of the clamp in 4/31 horses, one of which resulted in an open skin wound which required treatment.

Similarly, elastrator rings have been used to prevent ongoing herniation and stimulate inflammation to close the body wall defect. Greenwood and Dugdale (8) describe the application of 3 to 4 elastrator rings with the foal standing. Strong emphasis is placed on ensuring that no abdominal contents are present in the hernia sac before application of each ring. The elastrator rings can also be applied while in dorsal recumbency to aid in reducing all abdominal contents. The reported complication of this method is intestinal entrapment (8).

Umbilical hernias in horses are a common occurrence. Although complications are uncommon, they can make treatment more difficult and some cases can be life-threatening.
There are several methods of repair used for uncomplicated umbilical hernias; however, surgical repair is the only option for complicated hernias. It is important to discuss the benefits and risks of each treatment option with clients, and make a decision based on the suitability for each individual patient. If treatment is delayed to allow for spontaneous closure, it is essential that the hernia be closely monitored to allow early detection and treatment of complications, as was performed in this case, to optimize prognosis.

Acknowledgments

I thank the entire team at Prescott Animal Hospital and Rideau-St Lawrence Veterinary Services for their mentorship throughout my placement, and specifically, Drs. Jaimee Gardner and Ken Newman, DACVS for involving me in this case work-up.

References


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- Antimicrobial resistance in fecal Escherichia coli and Campylobacter spp. from beef cows in western Canada and associations with herd attributes and antimicrobial use on page 80
- Effect of passive transfer of immunity on growth performance of preweaned dairy calves on page 90
- Effect of full versus open-palm hand shielding on worker radiation dose during manual restraint for small animal radiography on page 154

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- Antimicrobial resistance in fecal Escherichia coli and Campylobacter spp. from beef cows in western Canada and associations with herd attributes and antimicrobial use à la page 80
- Effect of passive transfer of immunity on growth performance of preweaned dairy calves à la page 90
- Effect of full versus open-palm hand shielding on worker radiation dose during manual restraint for small animal radiography à la page 154

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One veterinarian’s experience with owners who are feeding raw meat to their pets

Lea Stogdale

In this opinion article, I discuss the approaches a veterinarian may take, and the consequences, when owners have decided, for whatever reasons, to feed their dog or cat a raw food diet, or to add raw meat to their pet’s other food, or to use as treats. A growing number of pet owners are choosing to feed raw meat-based diets (RMBDs) to their dogs and cats. In recent years, raw pet food sales have increased by at least 15% annually (1) and approximately 15% to 25% of dogs and 10% of cats are fed some raw meat. In addition, owners often add raw eggs or meat to an occasional meal, or give dehydrated RMBD treats to their pets (2), usually omitting to inform their veterinarian.

I will discuss the various types of raw pet foods, advantages and disadvantages of feeding raw food to dogs and cats, safety issues, and the challenges and opportunities that patients on raw diets present to veterinarians.

My priorities are always:

1. Safety for the family,
2. Safety for the pet,
3. That the pet is fed a complete and balanced diet,
4. That we find the food on which the pet thrives, and
5. That the feeding plan is practical for the client, now and in the future.

As no one diet suits every pet, during my nutritional consultations my pet feeding recommendations include the following options:

- Good quality commercial dog/cat food, dry and/or canned (the components vary but may include animal protein as the first ingredient, complex carbohydrates, and soluble fiber, but not include corn, wheat or soy, chemicals or artificial additives, colors, flavors, or preservatives),
- Home-prepared cooked complete and balanced diet,
- Commercial raw meat complete and balanced diet,
- Home-prepared raw meat complete and balanced diet,
- To any of these, add some human food, often fiber as vegetables, and
- Any combination of these options.

My recommendations depend upon an unhurried discussion with the client. Considerations include:

- What the client wants to feed,
- Family situation such as pregnancy, children under the age of 5 y, any immuno-compromised family members,
- Pet facial hair length (beards are difficult to clean after every meal),
- The pet’s nutritional history including which diets and foods the pet wants to eat,
- Pet health conditions such as significant disease, immune-mediated disease, and current medications,
- Owner financial concerns, and
- Client time constraints.

The final decision is always made by the pet owner. As the client and I discuss their choice of their pet’s diet, I note the client’s decision, and my recommendations and safety precautions in the pet’s medical record. Then I put together a complete and balanced diet appropriate for that pet. At the end of the appointment, a copy of my notes is sent home with the owner and e-mailed to their regular veterinarian.

Types of raw diets available for dogs and cats include:

- Commercial freeze-dried, freeze-dried, or dehydrated meat diets that are not complete and balanced. These require the addition of a combination of bones, a vitamin and mineral mix, vegetables, and fruit.
- Commercial raw frozen complete and balanced diets with a variety of protein sources. Some are limited to one protein source, especially those using exotic meats. Freezing kills a variable percentage of different species of microorganisms (3).
- Commercial freeze-dried complete and balanced diets that have been frozen under vacuum to remove nearly all moisture. Freeze-drying leaves the food nearly unchanged compared with raw frozen diets, and kills a percentage of bacteria (4).
- Commercial dehydrated complete and balanced diets have been heated slowly to remove nearly all the moisture. Whether the low heat has a significant effect on the

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nutritional quality of the food is unknown. The drying results in a reduction of microbial numbers but Salmonella and other pathogenic bacteria survive (5).

- **Commercial high pressure pasteurized (HPP) complete and balanced diets** have been subjected to high pressure (43,000 to 87,000 psi) without heating. This process kills most bacteria including Salmonella and Listeria (6) without altering nutritional quality.

Generally, raw pet diets are made from high quality food sources and aimed at the informed, discerning pet owner. They are more expensive than regular dog or cat kibble. The freeze-dried, dehydrated, and HPP foods are more costly than the raw frozen diets due to the additional processing. The costs may be substantial when feeding many cats or medium to large dogs. Nevertheless, solving a problem with diet is better for the pet and cheaper than repeated veterinary visits and expensive medications.

**Advantages of feeding a raw meat, complete and balanced diet to dogs and cats include:**

- If the owner believes that a raw diet is best for their pets, and wants to feed it, this is their choice. Some owners think that a commercial pet food is not good for their dog or cat, and prefer to feed a more natural diet (minimal processing, no grain, and ingredients that they can understand). Owners feeding RMBDs report that their pet has a healthier body condition, higher energy level, shinier coat, cleaner teeth, and normal bowel movements. They believe that their pet has fewer health problems (2).

- A raw diet is often considered to be the ancestral diet of pets (7,8). This is true for carnivorous cats. Several small rodents (6 to 12) a day is the ideal diet for each of our feline friends, but is impractical (7). However, dogs are omnivorous, carnivorous scavengers. They are physiologically adapted to eat everything: raw or cooked, meat, grain, vegetables, and rotten food (2,8), sometimes after rolling in it.

- RMBDs, as opposed to high protein cooked or extruded diets, are more biochemically complex with bioactive compounds. Raw diets are higher in antioxidants such as vitamin C, vitamin E, and some flavonoids (9). These may have some matrix effects and synergy that are beneficial to health (10). Heating food results in cooking toxins such as acrylamides and nitrosamines. These cause oxidative stress and are carcinogens (11). The effects of these compounds, interactions, or changes on the health of pets have not been studied.

- RMBDs may result in improved immune function. As 70% to 80% of each animal’s immune system is located within the intestinal tract wall, it is not surprising that food has a major influence on immunity, and therefore on disease predilection (12). However, direct health benefits have not been shown (2).

- My observations suggest that most dogs and cats fed RMBDs have a good, healthy body condition; they are not overweight. This may be due to twice daily, portion feeding, or to the high protein, low carbohydrate content (7). The cost of the diet may be a factor as the food is too expensive for overfeeding. In addition, these owners usually give their dogs limited numbers of good quality treats, such as dehydrated meat pieces.

In my experience, commercial or home-prepared raw diets can be medical problem solving for dogs and cats that have developed food allergies, especially to common meats such as chicken and beef. These allergies usually manifest as vomiting and/or diarrhea (including soft stool), recurrent ear infections, and/or excessive scratching or licking (13). Most commercial raw pet food limited ingredient diets (LID) are made in the company’s own grinding and mixing machines, and are generally not cross contaminated with other proteins. They are usually grain-free. The presence of bioactive peptides and antioxidants in RMBDs (9) may contribute to the response. Solving the food allergy problem by feeding a non-allergic food and treats is obviously the best approach, especially as these patients are corticosteroid resistant (13).

In some cats, diarrhea, intestinal discomfort, and/or flatulence can be caused by dietary carbohydrates. This is due to the feline carnivorous alimentary system being relatively short in length and transit time, along with limited capacity for starch digestion and monosaccharide absorption. Sugars that are not digested provide nutrients for microbial fermentation in the colon, increasing colonic acid (7). In cats which have developed diabetes, diets high in protein and very low in carbohydrates can be disease reversing or, at least, stabilizing (7). Feline RMBDs are typically higher in protein and lower in carbohydrate than most other cat diets.

This author could find no peer-reviewed articles that showed significant medical benefits from feeding RMBDs. There are many non-peer reviewed articles that suggest benefits to pets with food allergies, atopy, gastrointestinal disorders, idiopathic epilepsy, and cancer. However objective controlled studies are required.

In my experience, some dogs just “do better” on RMBDs. They are more active, lose excessive weight, have nicer breath, shiny coats, and normal feces. There is no good objective evidence that these diets improve the quality of the lives of dogs, or reduce the incidence of problems, but many pet owners firmly believe this to be so. It is very convincing in an individual patient when a food change makes a significant difference to the pet’s health and well-being, in the absence of other changes or medications at the time. In these cases, the patient is its own control, and the owner and the veterinarian can be delighted and thankful.

**Disadvantages of feeding a raw meat, complete and balanced diet to dogs and cats include:**

- Concerns over whether the diet is complete and balanced according to the Association of American Feed Control Officials (AAFCO) Dog or Cat Food Nutrient Profiles (2,7), especially with small companies which use only whole food ingredients, avoiding synthetic nutrient supplements. It is difficult to get all the vitamins and minerals from natural ingredients into muscle-based food in an economical combination. Vitamins and minerals usually must be added to a diet of meat and vegetables, and the calcium to phosphorus ratio needs to be approximately 1:1. Only a few raw pet food manufacturers have done the feeding trials to achieve AAFCO certification.

- Concerns over cost.
- Concerns over time. Most RMDBs require more time than simply feeding dry pet food.
• Not all pets tolerate raw diets, even with some vegetables added.
• Concerns over safety.

Safety issues associated with feeding RMBDs to dogs and cats
Most dogs and cats handle the bacteria in raw ground meat most of the time due to the consistent acidity of their stomach fluid (14). Occasionally, a dog fed raw meat does develop diarrhea from its food, but more commonly enteritis occurs due to dietary indiscretion.

Raw food is not appropriate for any dog or cat whose immune system is suppressed because of significant disease or immune suppressant medications. Pets with severe disease such as moderately advanced heart, kidney, or liver dysfunction, diabetes, or cancer should not be fed a raw diet that may contain pathogenic bacteria. If the owner wants to feed a high protein diet for diabetes or cancer, for instance, some raw diets may be cooked and vitamins added just before feeding, or an HPP product could be fed.

Safety for the owners
Meat (especially ground meat) and eggs for animal or human consumption carry microorganisms (2,15). Raw pet food poses similar risks for pathogenic bacteria as do raw meat and eggs for humans (2,15). Freezing, freeze-drying, or dehydration results in a reduction in bacterial counts but viable pathogenic bacteria survive (2–5,15). This is of real concern if the household includes, or is planning, pregnancy, children under 5 y of age, the elderly, or any person who is immuno-suppressed (2,15,16).

Information about safe meat handling is readily available from several sources (16,17). When safety is a concern for the owner, the family, or the pet, but a RMBD is preferred, an HPP food can be recommended (6).

In my many years of experience, I have found that most owners who feed raw commercial or home-prepared diets are informed and safety conscious. They practice safe food handling, dispose of their pets’ feces with care, and wash their hands frequently. Everyone needs to practice personal, pet, food (for humans and animals) and fecal sanitary habits due to the numerous recalls of human and pet foods because of bacterial contamination (2,15,18,19); and the fact that some healthy humans, dogs, and cats excrete Salmonella and other pathogens in their feces (20,21). With respect to zoonotic transmission of intestinal pathogens, numbers matter. The keys to understanding are 2 perceptive phrases: “The solution to pollution is dilution” and “size (in numbers) matters.” This is why washing with water, and a little soap, is usually effective, and is so widely recommended by public health experts.

Veterinarians do need to discuss both the possible benefits for the pet and the risks to the family’s animals and humans inherent in feeding RMBDs, and record their advice in the pet’s medical record.

Veterinary concerns and opportunities with clients feeding raw diets to their pets
Dog and cat patients fed raw diets raise some concerns for veterinarians:

• Safety for ourselves and our staff is the same as for our clients. We have to assume that all pets can be carriers of zoonotic microorganisms (20,21). Veterinarians and staff must engage in hygienic practices at all times.
• Our responsibility to advise our clients about safety, and potential problems for our patients. As we inform our clients about the risks of feeding RMBDs we need to record our recommendations and advice in the patient’s medical record.
• Various veterinary associations have issued position statements discouraging the use of RMBDs including the CVMA, AVMA, WSAVA, and AAHA (22–25). The CVMA and the BSAVA recommend that veterinarians advise owners who feed RMBDs to ensure that “hygiene measures are in place to minimize the risk of the transmission of communicable disease” (22,26).

As a veterinary specialist, I decide which therapies and pet management approaches I discuss with my clients, and:
• recommend a specific diet (e.g., LID diet, C&B pet food);
• recommend medication use that is off-label (e.g., albendazole, allopurinol, apomorphine, atenolol, and so on);
• advise owners who choose a strategy that I am unenthusiastic about (e.g., homeopathy);
• refer the client to a colleague (e.g., for physiotherapy or acupuncture); or
• disagree with but still support the client and the patient (e.g., owner declines rabies vaccination).

And in every case, I record my advice and the owner’s decision in the pet’s medical record, a copy of which is provided to the owner. I work with my clients so they have the best information for their decisions about the care of their pets.

Challenges and opportunities that patients on raw diets present to veterinarians
A surprising number of veterinary canine (15% to 25%) and feline (10%) patients are being fed RMBDs, and/or are being given raw meat, eggs, or treats in addition to their regular food (2,15). Clients have learned not to inform their veterinarian (and all too often veterinarians do not take a thorough dietary history) (27). Pet owners who choose to feed RMBDs have lower levels of trust in veterinary advice in general, as well as with respect to nutritional recommendations (27). These clients present opportunities for veterinarians, supportive and knowledgeable about the advantages and disadvantages of RMBDs, to provide veterinary services and advice to these generally well-informed and conscientious pet owners.

Clients who find that their veterinarian is only negative about RMBDs:
• Often omit or obfuscate what they are feeding their pet;
• Consider their veterinarian poorly informed about the best nutrition for their pet;
• May believe their veterinarian only cares about selling veterinary pet food and making money;
• May complain to their friends, in person and on social media, about their veterinarian;
• Distrust their veterinarian’s advice about both medical and nutritional issues, ignoring or questioning veterinary medical recommendations; and/or
• Take their pet veterinary needs elsewhere (27).
This is bad medicine and poor business for these veterinarians. This negative attitude generates business for those practitioners who are informed about RMBDs. And these veterinarians are already very busy. I find that being supportive of RMBDs gives me credibility when I advise clients against feeding raw food for any of the reasons discussed.

In summary, some of the best informed and conscientious clients are feeding their dogs and cats RMBDs. While raw pet foods are not suitable for most owners or all pets, some dogs and cats are healthier on these diets. Raw diets are effective in the management of some medical problems, especially gastrointestinal dysfunction. They can also resolve inappetence, obesity, and poor hair coat. Veterinarians should inform clients about the safety issues for the family members and the pet. Every pet diet should be complete and balanced. The additional cost and time that feeding a raw diet involves also need to be considered. All this information must be recorded in each patient’s medical record. In veterinary practices, thorough cleaning and disinfection with regard to pathogenic microorganisms is already carried out in our handling of all our patients and their elimination products. Nutrition and exercise are essential considerations as we strive to optimize the quantity and quality of each pet’s life for the enjoyment of their family.

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Time-sensitive communication

Myrna Milani

A n old saying reminds those new to animal training not to try to teach 2 behaviors simultaneously. This sounds reasonable enough. However, one mistake inexperienced trainers often make is to ignore an element inherent in the expression of every behavior: timing. Some people and animals are physically and mentally faster or slower than those with whom they interact in that same situation. This is normal. However, some people also assume that their timing is normal and that which they perceive as different from theirs is not. Although these time-related differences and beliefs superficially may appear to have nothing to do with quality communication in a veterinary practice, they may play a key role that is often overlooked.

Consider recent veterinary graduate Dr. Kalifa’s dilemma. When she accepted an associate’s position in Dr. Van Fleet’s practice, she could not imagine a position that could meet her needs better. Not only did the mixed practice enable her to work with farm and companion animals, it was located in a beautiful but rugged part of the country that appealed to her. Moreover, her new employer spent time acquainting her with the medical records of the practice’s clients and their animals before he sent her out on farm calls on her own. However, what neither he nor his staff members spent much time on was providing comprehensive directions to their rural clients’ locations. This occurred for 2 reasons: all the practice’s vehicles were equipped with GPS, plus Dr. Van Fleet and his other employees were familiar with the countryside.

Consequently, when Dr. Kalifa asked how long it would take her to get to her various appointments, they told her how long it took them to do that. They all also reminded her that the GPS would help her if she got lost. Those same dead zones also would foil her attempts to phone her clients to say she was going to be late, thereby compounding her problems. Even when it worked, the GPS could not warn which roads were apt to flood following a heavy rain.

Even though none of this information theoretically fell into the category of providing quality veterinary service, it could and did interfere with client communication a great deal. Consequently, keeping careful travel notes played an important role in Dr. Kalifa’s success during her first year. Similarly, she quickly realized that calling her clients to verify their location and information regarding any problems she might encounter on the way before leaving the clinic took less time than getting lost. More often than not, clients were very helpful and appreciated her desire not to keep them waiting.

But for as annoying as any time-related breakdowns in communication were before she even set foot in a barn or stall, these paled compared to those generated by timing discrepancies between her and some of her patients and clients.

No matter how much time she mentally allotted to accomplish a certain medical procedure in her own mind, experience taught her that not all animals would agree with this. Some animals normally maintained such a leisurely pace, it seemed to take them forever to cover the short distance between the paddock and their stalls. However, others always moved so fast she had little time to get out of the way if she did not want them to plow into her. Keeping notes regarding these timing idiosyncrasies in addition to her medical notes would help her avoid these problems and their repercussions in the future too.

Experience also taught Dr. Kalifa that clients could have their own ideas regarding how much time the veterinarian should devote to their animals and them. Bob Brown constantly looked at his watch and sighed when Dr. Kalifa was examining one of his animals. This created a dilemma for the practitioner. She did not want to upset the client, but she did not want to give the animal substandard care either.

Georgia Greene was the opposite. She demanded that Dr. Kalifa spend what the practitioner considered an excessive amount of time addressing the client’s most insignificant concerns about her horse. And whereas Bob Brown was so anxious for Dr. Kalifa to leave that the practitioner worried the client had not heard a thing she said, Ms. Greene viewed every visit from the veterinarian as an opportunity to bring her up to date.

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on every change that occurred on her property since Dr. Kalifa’s or Dr. Van Fleet’s last call.

Because Dr. Kalifa was a punctual person by nature, these situations that caused her to be late initially struck her as the most problematic. When Ms. Greene’s call took 2 hours instead of the hour the practitioner estimated, Dr. Kalifa would call her next client — if cell service permitted this — to apologize for the delay and otherwise placate the client if possible. But doing this took time, too. If she encountered a string of such delays, her own and the client’s distress regarding her tardiness could be considerable by the time she arrived at her last appointment.

When those days occurred, Dr. Kalifa looked forward to seeing clients like Bob Brown who just wanted her to vaccinate his animals or whatever and go away, the sooner the better. But although those abbreviated client-animal interactions did provide the practitioner with an opportunity to catch up, inevitably they would bother her as much as the time-vampires.

“I keep thinking I might have missed something,” she told Dr. Van Fleet when he asked her how her appointment with Bob Brown went when she returned to clinic.

Her employer assured her that Brown treats him and many other people that same way.

“Bob’s a crotchety old curmudgeon, but he knows his animals and I respect that,” Dr. Van Fleet continued. “But he also knows that I note it in the animal’s record if he doesn’t give me enough time to do a comprehensive physical examination, get a good history, or administer a certain treatment when I believe these are needed. That’s my way of telling him he better keep a close eye on that animal and call immediately if any problems arise. And so far, he always has.”

Knowing this makes his new associate feel much better, as does Dr. Van Fleet’s apology for not telling the office manager to schedule more time for Dr. Kalifa’s appointments to give her more time to adjust. That plus her navigation-, patient-, and client-related notes did wonders to diminish those time-related worries that had plagued her.

Client and animal time-related communications issues when Dr. Kalifa saw companion animals and their owners at Dr. Van Fleet’s hospital also benefitted from the notes she had made and the insights her employer had shared. However, she also needed to adjust to any timing issues related to the in-house veterinary staff. This consisted of the business manager and front office staff, technicians, kennel help, and 2 part-time companion animal associates. Despite these people possessing the potential to generate more schedule-altering variables, working with them in a fixed location with a support staff did make it easier to make any schedule changes should these become necessary.

Like many practitioners, Dr. Kalifa also came to prefer working with certain members of the staff. She found all of them competent, but she and those particular ones worked together more smoothly. They accomplished their work more efficiently which benefitted the animals as well as themselves.

“It reminds me of working with certain animals,” she told Dr. Van Fleet. “It’s all about matching their timing instead of trying to change it. Once you do, everything clicks. Instead of being involved in a push-pull interaction, it’s more like a dance. The people I enjoy working with the most are those whose timing is similar to mine. It enables us to anticipate what the other will do and communicate our respective expectations and needs concisely. It’s practice-related communication at its best.”

When Dr. Kalifa joined Dr. Van Fleet’s practice, naturalist/philosopher Henry David Thoreau’s idea of stepping to the music of a different drummer no matter the beat or how far away the sound appealed to the novice veterinarian. Though she did not consider herself inflexible, she did consider herself “the most knowledgeable authority on all things animal” at that time. But be that though it may, she soon discovered that her knowledge did not include the effects of timing within the practice setting. It did not — or should not — apply to imposing her own sense of timing on clients and their animals, or colleagues. In that setting, it meant finding a tempo that worked for both of them.

Once the practitioner mastered this skill, she discovered that those once highly irritating time discrepancies ceased being problematic. She also discovered that her willingness to adapt increased the likelihood that her patients and clients would too.

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