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The past 6 years while on the Canadian Veterinary Medical Association (CVMA) Council I have been fortunate to have experienced veterinary medicine on the national and international levels. Before the Saskatchewan Veterinary Medical Association and the CVMA, veterinary medicine revolved around the practice where I worked and an annual trip for continuing education; how small my world was then.

I cannot stress enough how important it is to see the veterinary profession as a worldwide community. We need to see beyond our clinic walls, and provincial and country borders to protect animal and human health, and keep international trade thriving. Forty percent of the Certificates of Qualification granted in 2017 were to veterinarians educated outside of Canada. Animals can travel across the world in 24 hours. The public and veterinarians can access information around the world in minutes. These are but a few examples that highlight the importance of understanding and being engaged with what happens outside of Canada. It is essential that Canadian veterinarians have strong international representation.

The CVMA represents Canadian veterinarians on 11 international bodies. The CVMA president is a member of the delegation that the Government of Canada sends to the General Assembly of the World Organization for Animal Health (OIE), an organization of 181 member countries. The OIE assessed Canada’s veterinary services in 2017 and stated Canada was a leading example for meeting international veterinary services with no major weaknesses, while awarding the majority of veterinary services a 5 out of 5 score. The goal of the OIE is to promote the health of animals, protect the public from animal disease, and strengthen international trade and economic opportunities. The full report is available on the OIE website.

The CVMA is a Council member of the World Small Animal Veterinary Association (WSAVA), whose mission is to advance the health and welfare of companion animals worldwide. Some of the services Canadian veterinarians are able to access through this membership are preferred access to Clinician’s Brief, Canada’s role in global veterinary medicine
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Over the past 6 years while on the Canadian Veterinary Medical Association (CVMA) Council I have been fortunate to have experienced veterinary medicine on the national and international levels. Before the Saskatchewan Veterinary Medical Association and the CVMA, veterinary medicine revolved around the practice where I worked and an annual trip for continuing education; how small my world was then.

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VetFolio, and Plumb’s Veterinary Drugs; we can also participate in developing position statements that promote small animal veterinary medicine throughout the world. Canadian veterinarians can access the WSAVA Guidelines for the Recognition, Assessment and Treatment of Pain as well. There will be a joint conference in July 2019 between WSAVA and the CVMA. Experts from around the world will be speaking on “The Gold Standard of Animal Welfare” along with the CVMA Global Forum on Telehealth and Animal Welfare.

The Federation of Veterinarians of Europe (FVE) is made up of 38 member countries. The FVE, American Veterinary Medical Association (AVMA) and the CVMA maintain a “Letter of Association” or collaboration agreement with the objective of working together to advance animal health and welfare, public health, veterinary education, veterinary science and to promote the veterinary profession. Joint position statements have been drafted on the responsible use of antimicrobials, the benefits of animal vaccination, and the global control of rabies. According to the World Health Organisation more than 55 000 people die of rabies every year. The joint position on the global control of rabies is to highlight the importance of working together to assist countries in the control of canine rabies and to encourage organizations to work effectively and collaboratively. Resources and information are available on the CVMA website.

The CVMA is a board member of PanVet (Pan American Association of Veterinary Sciences). There is real concern that due to animal movement, emerging diseases in Latin America may spread north. The goal of participating on this board is to strengthen veterinary medicine in the Americas.

Mentorship continues to be one of the main services that recent graduates ask for from the CVMA. The International Veterinary Officers Coalition is made up of the veterinary associations of the United States, Canada, Great Britain, Australia, New Zealand and South Africa. It is this collaboration that resulted in the generous sharing of the British Veterinary Association and the Australian Veterinary Associations’ mentorship programs with Canada, resulting in the CVMA’s Mentoring Program Guide available on the website.

The United States, Mexico and Canada form the North American Veterinary Leaders. The joint position statement on Horse Slaughter is an example of this collaboration. This position statement addresses euthanasia and the appropriate disposal for horses that are no longer serviceable and have no home to go to or place to be trained. While addressing the welfare aspects of horses, the goal of this position is to also minimize risks to the public and environment.

The AVMA and the CVMA have partnered for 70 years. The AVMA and the CVMA each have a member on their respective veterinary technician accreditation committees and the Animal Welfare Committees. The CVMA is on the AVMA’s Council on Education (CoE), which accredits DVM programs ensuring minimum standards in veterinary education, and on the Educational Commission for Foreign Veterinary Graduates (ECFVG). Both countries work closely together on antimicrobial resistance (AMR), telehealth, and several other important issues. This has always been a very close relationship with a generous sharing of information, documents and resources.

L’ACMV est membre du Conseil de la World Small Animal Veterinary Association (WSAVA), qui a pour mission de faire avancer la santé et le bien-être des animaux de compagnie partout dans le monde. Parmi les services offerts aux médecins vétérinaires canadiens grâce à cette adhésion, signalons les publications Clinician’s Brief, VetFolio et Plumb’s Veterinary Drugs. Nous pouvons aussi participer à l’élaboration d’énoncés de position qui font la promotion de la médecine vétérinaire des petits animaux partout dans le monde. Par ailleurs, les médecins vétérinaires canadiens peuvent accéder aux Lignes directrices de la WSAVA pour la reconnaissance, l’évaluation et le traitement de la douleur. En juillet 2019, il se tiendra d’ailleurs une conférence conjointe entre la WSAVA et l’ACMV. Des experts partout dans le monde aborderont le sujet de «La norme d’excellence en matière de bien-être animal» et le Forum mondial de l’ACMV se penchera sur la télésanité et le bien-être animal.

La Fédération des vétérinaires d’Europe (FVE) se compose de 38 pays membres. La FVE, l’American Veterinary Medical Association (AVMA) et l’ACMV ont signé une «Lettre d’association», soit une entente de collaboration, dans l’objectif de travailler de manière concertée afin d’avancer la santé et le bien-être des animaux, la santé publique, l’enseignement de la médecine vétérinaire, la science vétérinaire ainsi que de promouvoir la profession vétérinaire. Des énoncés de position conjoints ont été rédigés sur l’utilisation responsable des antimicrobiens, les avantages de la vaccination des animaux et le contrôle mondial de la rage. Selon l’Organisation mondiale de la santé, chaque année, plus de 55 000 personnes meurent de la rage. La position conjointe sur le contrôle mondial de la rage consiste à souligner l’importance d’une collaboration afin de porter assistance aux pays pour contrôler la rage canine et à encourager les organisations à travailler d’une manière efficace et concertée. Des ressources et des renseignements sont disponibles sur le site Web de l’ACMV.

Par ailleurs, l’ACMV est membre du Conseil de PanVet (Pan American Association of Veterinary Sciences). Il existe des préoccupations réelles que, en raison du mouvement des animaux, les maladies émergentes présentes en Amérique latine puissent se propager vers le nord. La participation à ce conseil d’administration a pour but de renforcer la médecine vétérinaire dans les Amériques.

Le mentorat continue d’être un des principaux services réclamés par les diplômés récents auprès de l’ACMV. L’International Veterinary Officers Coalition se compose des associations de médecins vétérinaires des États-Unis, du Canada, de la Grande-Bretagne, de l’Australie, de la Nouvelle-Zélande et de l’Afrique du Sud. C’est une collaboration qui a permis le généreux partage des programmes de mentorat de la British Veterinary Association et de l’Australian Veterinary Association avec le Canada, ce qui s’est traduit par la publication du guide du Programme de mentorat de l’ACMV sur le site Web.

Les États-Unis, le Mexique et le Canada forment le groupe des Leaders vétérinaires de l’Amérique du Nord. L’énoncé de position conjoint sur l’abattage des chevaux représente un exemple de cette collaboration. Cet énoncé de position aborde l’euthanasie et l’élimitation appropriées des chevaux qui ne sont plus utiles et qui n’ont pas trouvé de foyer ou de lieu d’entraînement. Le but...
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- CVMA Green Veterinary Practice and self-audit tool
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- Plumb’s Veterinary Drugs™ (subscription discount)
- Staples Advantage™ business products
- Adtel® telephone hold service and digital signage (preferred pricing)
- Petro-Canada SuperPass™ fuel/diesel discount
- WSAVA World Congress (registration discount)
- WVA Congress (registration discount)

Visit our website or contact us to learn how to get more value from your membership.

10/2018
The CVMA has a board member on the Pet Nutrition Alliance (PNA). The PNA provides resources for the veterinary team for patient assessment, developing nutrition plans, and to help navigate the complex world of pet food. The PNA’s goal is to create awareness that veterinarians and registered veterinary technicians are the most reliable sources for information regarding pet nutrition.

The CVMA’s National Examining Board (NEB) has a representative on the AVMA’s ECFVG. The ECFVG oversees the certification of graduates of non-accredited veterinary schools and provides the NEB with the Basic and Clinical Sciences Examination. The ECFVG and the NEB share and maintain the Clinical Proficiency Examination (CPE).

The CVMA’s NEB is represented on the International Council for Veterinary Assessment (ICVA). The ICVA is the NEB’s provider of the North American Veterinary Licensing Examination (NAVLE).

This is only a brief outline of what the CVMA does for Canadian veterinarians internationally. I encourage all of you to use the available resources and to familiarize yourself with the CVMA’s involvement on the world stage.

Terri Chotowetz
Ethical question of the month — January 2019

Even prior to the legalization of recreational marijuana in Canada you received regular queries regarding the use of cannabinoids to treat dogs and cats. You have been careful to explain that there is little research on the use of cannabis-based products to treat dogs and cats. Nevertheless, owners regale you with stories from friends and relatives whose arthritic or epileptic pet became asymptomatic following treatment with a cannabinoid product. Commonly these stories include the fact that until the cannabinoid was used, the family's veterinarian had been unable to relieve the animal's suffering. It is apparent some clients believe you will not even provide a dosage because you wish to protect your prescription drug sales. Today you are treating a dog with an apparent cannabis overdose after the owners decided to experiment with products and dosages on their own. The testimonials on the Internet are winning out over your professional conservatism. How should you respond?

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

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

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Ethical question of the month — October 2018

Some animal rights advocates argue that humane meat is an oxymoron. They believe killing an animal simply for human benefit is never humane. Other animal rights groups believe that advocating for humane meat improves the lives of more animals more rapidly than promoting a vegan lifestyle. Those involved in conventional animal agriculture believe that humanely raised livestock as well as veganism are passing fads and that modern livestock production has a smaller environmental footprint than humane meat. As a food animal veterinarian with both conventional and humanely raised livestock clients as well as friends and relatives who inquired about animal rights and veganism, you are looked to as a reliable source of information on these matters. It is a struggle, however, for you to stay current in veterinary practice without getting involved in animal welfare controversies. How should you respond to those who seek your counsel in these matters?

Question de déontologie du mois — Octobre 2018

Certains défenseurs des droits des animaux font valoir que la viande éthique est un oxymoron. Ils croient que le fait de tuer un animal simplement pour le bénéfice des humains n’est jamais un geste sans cruauté. D’autres groupes des droits des animaux croient que la préconisation d’une viande produite de manière éthique améliore la vie de plus d’animaux, plus rapidement, que la promotion d’un style de vie végétalien. D’autre part, les personnes travaillant dans l’agriculture animale conventionnelle croient que l’élevage éthique du bétail et le végétalisme sont des modes passagères et que la production du bétail moderne a une empreinte écologique inférieure à celle de la viande produite de manière éthique. Étant donné que vous êtes un vétérinaire pour animaux destinés à l’alimentation ayant des clients possédant du bétail élevé selon des méthodes conventionnelles et selon des méthodes éthiques, des amis et des parents qui désirent s’informer à propos des droits des animaux et du végétalisme se tournent vers vous comme source fiable d’information. Cependant, vous peinez à demeurer au courant de la pratique vétérinaire sans vous mêler à des controverses en matière de bien-être animal. Comment devriez-vous répondre aux personnes qui sollicitent vos conseils sur ces questions?

An ethicist’s commentary on how does a veterinarian answer queries regarding meat consumption

This case vividly reminds me of some superb advice I received from a colleague who was a laboratory animal veterinarian, David Neil, who had an eminent career working in Britain and then for the Canadian Council on Animal Care in Canada before coming to my university. We were working on drafting legislation at a United States federal level requiring the use of analogesia for experimental animals that will experience pain. (As I have mentioned before, a comprehensive literature search conducted at the Library of Congress by a librarian there in 1982 who was a friend of mine revealed not a single paper on the topic!). At any rate, my veterinarian friend asked us all to create a “wish list” for what we wanted to see included in our proposed legislation. I was having a merry old time listing every kind of invasive research I could think of, and suggesting that they all be banned. After this fantasy session ended, the veterinarian said “now that we have gotten that out of our systems, let’s get down to some real work.”

Living in a quasi-fantasy world is endemic among passionate animal advocates. Though the vast majority of citizens wish to see farm animals treated well and given a painless death, relatively few are willing to sacrifice animal products to achieve that goal. Evidence for my claim comes from the fact that the percentage of the population who are vegans remains pretty constant over many years. Currently, only 0.5% of the United States population is vegan. On the other hand, over 90% wish to see farm animal welfare legislated.

In contrast, about 50% of the United States population finds invasive research on animals morally wrong. When I was proposing the above-mentioned bill to the United States Congress, there was a woman proposing another bill, whereby the federal research budget would be cut by a very high percentage and the money plowed into “alternatives.” When I asked her what she meant by an “alternative,” she waved her hands in the air and affirmed “Oh you know, a plastic dog that howls when it is cut so the scientists can do their research on that.” The point is that the majority of the public has not thought through their position on animal ethics very clearly. So what is the veterinarian in this case to do?

Shortly after our initial meeting, Dr. Neil sat me down for a heart-to-heart discussion. He opined that I appeared to him to have a very deep and very strong commitment to improving the well-being of animals. If that is the case, he continued, I needed to take stock every few months of the results of my activity in the area, and ask myself if the animals are any better off by virtue of my efforts. If the answer is no, my activity is self-centered, aimed at making me feel good, but doing nothing for the objects of my concern. I suddenly felt as if my eyes had been opened, and I now understood what I must do. That has been my guiding principle ever since, and thus I was incredibly gratified when, in the early 21st century, I was given a national award for being the person who had eliminated the most animal pain in the previous century!
44th World Small Animal Veterinary Association Congress & 71st Canadian Veterinary Medical Association Convention
16-19 July, 2019
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This is precisely the position in which our hypothetical veterinarian finds himself or herself. Thus he or she needs to spend some careful time thinking through their position on the well-being of farm animals. He or she then must commit to expressing it in a pithy manner intelligible to those by whom he or she is queried. Having done the same thing myself, I can attest to the fact that the task is not as onerous as it sounds. The veterinarian should articulate clear positions on industrially raised animals, animals raised under good husbandry conditions, animals transported, handled, and slaughtered with and without pain, fear, and distress, as well as on the contentious issue of meat created by biotechnological modalities without harming or killing animals.

This can probably be done at an introductory level in a few weeks and is an invaluable activity for one who is widely seen, as the case attests, as an expert and as an educator. (The role of veterinarian as educator pertaining to animal issues is often neglected.) In that way, the veterinarian can help assure that people’s positions are well-informed and well-thought out, and are not simply poorly reasoned, knee-jerk emotional reactions. This is a great service not only to the people one educates, and to the animals, but to society as a whole.

Bernard E. Rollin, PhD
1. Cataracts develop in dogs with diabetes mellitus for which of the following reasons?
   A. The increased glucose within the aqueous humor dehydrates the lens.
   B. The increased glucose causes formation of sorbitol within the aqueous humor.
   C. The increased glucose within the lens draws in water, destroying the lens fibers.
   D. The increased glucose causes formation of sorbitol within the lens.

2. Lufenuron is a flea-control product for dogs and cats. Which of the following is thought to be its mechanism of action?
   A. It blocks voltage-gated channels.
   B. It is an insect development inhibitor that arrests flea exoskeleton development.
   C. It binds invertebrate nicotinic acetylcholine receptors and blocks neurotransmission.
   D. It is an insect growth regulator that mimics the effects of endogenous juvenile insect growth hormones.
   E. It potentiates the action of the inhibitory neurotransmitter γ-aminobutyric acid.

3. The MAC (minimum alveolar concentration) value is a measure of which of the following?
   A. How fast an anesthetic works
   B. How fast an anesthetic evaporates
   C. The alveolar concentration resulting in anesthesia in 100% of the animals
   D. The potency of the inhalation anesthetics

1. Chez les chiens souffrant de diabète sucré, laquelle des raisons suivantes favorise le développement de cataractes?
   A. L’augmentation du glucose dans l’humeur aqueuse déshydrate le cristallin.
   B. L’augmentation du glucose favorise la formation de sorbitol dans l’humeur aqueuse.
   C. L’augmentation du glucose dans le cristallin retire l’eau, détruisant les fibres du cristallin.
   D. L’augmentation du glucose cause la formation de sorbitol dans le cristallin.

2. Le lufénuron est un produit utilisé pour lutter contre les puces chez les chats et les chiens. Quel est son mécanisme d’action?
   A. Il bloque le canal ionique potentiel-dépendant.
   B. C’est un inhibiteur du développement de l’insecte qui arrête le développement de l’exosquelette de la puce.
   C. Il lie les récepteurs de l’acétylcholine nicotinique des invertébrés et bloque la neurotransmission.
   D. C’est un régulateur de la croissance de l’insecte qui imite les effets des hormones de croissance endogènes de l’insecte juvénile.
   E. Il potentilise l’action du neurotransmetteur inhibiteur de l’acide gamma-aminobutyrique.

3. La valeur de la concentration alvéolaire minimale (CAM) est une mesure de quel phénomène suivant?
   A. Rapidité d’action d’un agent anesthésique.
   B. Rapidité d’évaporation d’un agent anesthésique.
   C. La concentration alvéolaire produisant l’anesthésie chez 100 % des animaux.
   D. La puissance des agents anesthésiques volatils.
4. A 9-year-old castrated male cocker spaniel has a history of polyuria and polydipsia and has an elevated alkaline phosphatase (ALP) concentration. Morning urine is collected at home, and the UCCR is determined to be 36 (reference range: 8 to 24). Which of the following is the best interpretation of these results?
A. This dog has hyperadrenocorticism, and treatment should be initiated.
B. This dog may have hyperadrenocorticism, and further adrenal function testing is indicated.
C. This dog does not have hyperadrenocorticism.
D. The elevation of the UCCR is due to stress.
E. This dog has hypoadrenocorticism.

5. Dogs infected with which of the following organisms can shed oocysts in feces that can then infect cattle, causing abortion?
A. Coccidioides immitis
B. Neospora caninum
C. Hepatozoon americanum
D. Leishmania infantum
E. Toxoplasma gondii

Questions and answers were derived from Review Questions and Answers for Veterinary Boards 2nd ed., a 5-volume series including Basic Sciences, Clinical Sciences, Small Animal Medicine and Surgery, Large Animal Medicine and Surgery, and Ancillary Topics, by kind permission of the publisher, Mosby–Year Book, Inc., St. Louis, Missouri.

Welcome to the Profession Future Veterinarians!

The Canadian Veterinary Medical Association (CVMA) supports all future veterinarians on their journey toward their new career and gives every Canadian veterinary student full CVMA membership. Also, every fall, each Canadian veterinary college hosts a lab coat ceremony where the CVMA presents 1st-year students entering the veterinary profession with a CVMA embroidered laboratory coat and personalized name badge. Please join us in welcoming these students; the future of the Canadian veterinary profession!

Bienvenue à la profession de médecin vétérinaire!

L’Association canadienne des médecins vétérinaires (ACMV) appuie tous les futurs vétérinaires dans leur parcours qui les mènera vers leur nouvelle carrière et tous les étudiants en médecine vétérinaire du Canada sont membres à part entière de l’ACMV. De plus, chaque faculté de médecine vétérinaire organise une cérémonie annuelle des sarraus à l’automne. Lors de ces cérémonies, l’ACMV présente un sarrau de laboratoire brodé et un insigne d’identité personnalisé aux étudiants de première année entrant dans la profession. Veuillez vous joindre à nous pour accueillir ces étudiantes et étudiants qui représentent l’avenir de la profession vétérinaire!
Université de Montréal Faculté de médecine vétérinaire Class of 2023.
Promotion 2023 de la Faculté de médecine vétérinaire de l’Université de Montréal.

Atlantic Veterinary College Class of 2022.
Promotion 2022 de l’Atlantic Veterinary College.
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Promotion 2022 de la Faculté de médecine vétérinaire de l’Université de Calgary.

Western College of Veterinary Medicine Class of 2022.
Promotion 2022 du Western College et Veterinary Medicine.
2019 CVMA Awards — Last Call!
Nominations Close January 31, 2019

Prix de l’ACMV 2019 — Dernier appel!
Clôture des mises en candidature le 31 janvier 2019

Each year, through the Canadian Veterinary Medical Association’s (CVMA’s) national veterinary awards program, veterinarians are honored for their exceptional contributions to veterinary medicine. We encourage you to nominate deserving colleagues for their hard work and dedication to the profession.

“I am extremely humble,” shares Dr. Kathleen Parker, the 2018 recipient of the Merck Veterinary Award. “There are a lot of really important people who have influenced the profession and the industry, and I am really privileged to be on that list.

“I am even more overwhelmed that the people who supported this are the young vets. It means a lot when young veterinarians value your input and your support. There are no words to describe how much this means to me. I’m just me, just here in the middle of nowhere doing my thing and they chose to recognize me,” adds Dr. Parker.

Award nominees (excluding those nominated for Honorary Membership) must be current CVMA members to be eligible for nomination; however, they can be nominated by non-CVMA members.

CVMA Awards will be presented during the CVMA Convention, which takes place in Toronto, Ontario from July 16 to 19, 2019. Nominations are accepted until January 31, 2019 for the following awards:

CVMA Humane Award (Sponsored by Merck Animal Health)
Merck Veterinary Award (Sponsored by Merck Animal Health)
Small Animal Practitioner Award
(Sponsored by Petsecure Pet Health Insurance)
CVMA Practice of the Year Award (Sponsored by Scotiabank)
CVMA Industry Award
CVMA Life Membership
CVMA Honorary Membership

Nomination packages must be submitted by January 31, 2019 via e-mail (communications@cvma-acmv.org), by fax to 613-236-9681, or by mail to the CVMA office at 339 Booth Street, Ottawa, ON K1R 7K1.

Nomination packages must include a completed nomination form, an outline of the nominee’s key professional accomplishments, and letters of support (newspaper articles and articles written by the nominee can be included if applicable).

Please visit the CVMA Awards section of the website (www.canadianveterinarians.net), under About CVMA, for complete nomination guidelines, award descriptions, nomination forms, and past award recipients.

Chaque année, dans le cadre du programme national des prix vétérinaires nationaux de l’Association canadienne des médecins vétérinaires (ACMV), des vétérinaires sont honorés pour leurs contributions exceptionnelles à la médecine vétérinaire. Nous vous encourageons à mettre en candidature des collègues méritants pour leur travail ardu et leur dévouement envers la profession.

« Je me sens extrêmement humble », confie la Dʳ Kathleen Parker, récipiendaire 2018 du Prix vétérinaire Merck. « Il y a une foule de personnes vraiment importantes qui ont influencé la profession et l’industrie et je suis réellement privilégiée de figurer sur cette liste. »

« Je suis encore plus honorée que les personnes qui ont appuyé cette candidature ont été les jeunes médecins vétérinaires. C’est impressionnant lorsque les jeunes médecins vétérinaires apprécient votre rétroaction et votre soutien. Il n’y a pas de mots pour décrire ce que cela signifie pour moi. Je suis simplement moi, ici au milieu de nulle part, pour faire mon travail et ils ont choisi de m’honorer », ajoute la Dʳ Parker.

Les candidats (sauf ceux mis en candidature pour le titre de membre honoraire) doivent être des membres en règle de l’ACMV pour être admissibles à la mise en candidature. Cependant, ils peuvent être mis en candidature par des non-membres de l’ACMV.


Prix humanitaire de l’ACMV
(Commandité par Merck Santé Animale)
Prix vétérinaire Merck (Commandité par Merck Santé Animale)
Prix du praticien des petits animaux
(Commandité par Petsecure assurance maladie pour animaux)
Prix de la pratique de l’année de l’ACMV
(Commandité par la Banque Scotia)
Prix de l’industrie de l’ACMV
Membre à vie de l’ACMV
Membre honoraire de l’ACMV

Les trousses de mise en candidature doivent être soumises d’ici le 31 janvier 2019 par courriel (communications@cvma-acmv.org), par télécopieur au 613-236-9681 ou par la poste au bureau de l’ACMV au 339, rue Booth, Ottawa (Ontario) K1R 7K1.

Les trousses de mise en candidature doivent inclure un formulaire de mise en candidature rempli, une description sommaire des principales réalisations professionnelles du candidat et des lettres d’appui (des articles de journaux et des articles écrits par le candidat peuvent être inclus au besoin).
Experience Toronto:
Discover the World
July 16–19, 2019

The Canadian Veterinary Medical Association (CVMA) is bringing the world to Canada in this joint Congress between the World Small Animal Veterinary Association (WSAVA) and the CVMA.

Online registration for the congress is already open. Be sure to visit the CVMA website for a breakdown of pricing and how you can save as much as 20% on your registration if you register prior to April 10, 2019. Registration fees are in Canadian dollars and include taxes.

The WSAVA/CVMA Congress offers over 50 different streams with continuing education (CE) topics including Dentistry, Dermatology, Business Management, Exotics, Feline Medicine, Equine Welfare, Equine Diagnostic Imaging, and much more. Visit the CVMA website for more details on the scientific program.

The World Congress will also feature several CVMA signature events that you can partake in, including: the CVMA Summit facilitated by CVMA’s president-elect, Dr. Melanie Hicks; the CVMA National Issues Forum; and the Emerging Leaders Program. These events offer unique networking, engagement, and learning opportunities.

If you are looking for a hotel near the hustle and bustle of the Congress, look no further. WSAVA has secured multiple hotels within walking distance of the Metro Toronto Convention Centre. All hotel rates do include all applicable taxes.

*NEW* for 2019: CVMA is looking for high quality photos to promote our diverse country to the world during the Opening Ceremony. Submit your photo online before January 25, 2019 by visiting the CVMA Convention website and you will be entered into a draw for a chance to win a complimentary registration to the 2019 World Congress or 2 tickets to the 2019 social evening.

(by Sarah Cunningham, Manager, Conventions)

Visitez Toronto:
Découvrez le monde
Du 16 au 19 juillet 2019

L’Association canadienne des médecins vétérinaires (ACMV) invite le monde au Canada lors de ce congrès conjoint entre la World Small Animal Veterinary Association (WSAVA) et l’ACMV.

L’inscription en ligne pour le congrès est déjà ouverte. Assurez-vous de visiter le site Web de l’ACMV pour vous renseigner à propos du tarif et de la façon dont vous pouvez économiser jusqu’à 20 % sur votre inscription si vous vous inscrivez avant le 10 avril 2019. Les tarifs d’inscription sont en dollars canadiens et incluent les taxes.

Le congrès WSAVA/ACMV présentera plus de 50 différents volets offrant de la formation continue portant notamment sur la dentisterie, la dermatologie, la gestion commerciale, les animaux exotiques, la médecine féline, le bien-être équin, l’imagerie diagnostique des équidés et plus encore. Visitez le site Web de l’ACMV pour en savoir davantage sur le programme scientifique.

Le congrès mondial présentera aussi plusieurs événements phares de l’ACMV auxquels vous pourrez participer, notamment : le Sommet de l’ACMV qui sera animé par la présidente désignée de l’ACMV, la Dr. Melanie Hicks; le Forum sur les enjeux nationaux de l’ACMV et le Programme des futurs leaders. Ces événements offrent des occasions uniques de réseautage, de participation et d’apprentissage.

Si vous désirez un hôtel près de l’action du congrès, ne cherchez pas plus loin. La WSAVA a réservé plusieurs hôtels à distance de marche du Metro Toronto Convention Centre. Tous les tarifs d’hôtel incluent toutes les taxes.


(par Sarah Cunningham, Gestionnaire, Congrès)
Collaborative Program Re-engages Inactive Clients and Brings Them Back into Veterinary Practice

The Canadian Veterinary Medical Association (CVMA) is a proud Associate Member of Partners for Healthy Pets (PHP). The Association is pleased to announce another program between PHP, Veterinary Medical Association Executives (VMAE) and the CVMA. This initiative, just like last year’s Forwarding Booking program, will have a significant impact on the health of your patients and your practice.

This collaborative program focuses on the importance of re-engaging Inactive Clients and bringing them back into the veterinary practice. This is not your typical reminder program! First, it is based upon a client’s visitation history and not a timetable for a specific service. Second, a key difference is in the messaging itself. PHP’s unique empathetic messaging consists of 3 compelling points: recognizing that pet owners are busy but want to provide the best care for their pets; expressing sincere concern from the practice for their pets’ health; and conveying that an annual exam is as important as food and love. This program does not replace, but is actually complementary to, your current reminder program.

Not convinced? During 2015–2016, 1612 practices enrolled in PHP’s Inactive Client Reminder Program, which resulted in reactivating an average of 128 clients per practice (many of whom had been absent for 2 to 3 years). This led to healthier pets and healthier practices!

The even better news is that this program is incredibly easy to utilize as it involves no staff training or changes to your practice team protocols. You need only to assign 1 or 2 staff members to identify lapsed clients and the rest is as easy as 1, 2, 3!

**STEP 1:** Identify inactive clients.

**STEP 2:** E-mail those clients with PHP’s proven and ready-to-use compassionate messaging.

**STEP 3:** Start booking appointments!

To get started, go to the Partners for Healthy Pets website (www.partnersforhealthypets.org/inactive_client_program.aspx) and review the readily accessible resources provided: A copy of the Inactive Client Reminder Program white paper; a webinar explaining the compelling and proven results of the program; and the easy-to-use e-mail templates with PHP’s unique and proven pet owner communications.

The CVMA is excited to provide this opportunity to you and your practice. It’s as easy as 1, 2, 3!

Un programme collaboratif renoue le contact avec les clients inactifs et les ramène à la clinique vétérinaire

L’Association canadienne des médecins vétérinaires (ACMV) est fière d’être membre associé de Partners for Healthy Pets (PHP). L’Association est heureuse d’annoncer un autre programme entre PHP, les Veterinary Medical Association Executives (VMAE) et l’ACMV. Cette initiative, tout comme le programme de la prise de rendez-vous à l’avance de l’an dernier, aura un impact important sur la santé de vos patients et de votre clinique.

Ce programme collaboratif porte sur l’importance de renouer le contact avec les clients inactifs et de les ramener à la clinique vétérinaire. Il ne s’agit pas ici de votre programme de rappel habituel! D’abord, il se fonde sur les antécédents de visite du client et n’est pas un calendrier pour un service particulier. Deuxièmement, une différence clé est le message en soi. Le message empathique unique de PHP se compose de trois éléments cruciaux : reconnaître le fait que les propriétaires d’animaux sont occupés mais désirent les meilleurs soins pour leurs animaux; exprimer une préoccupation sincère de la part de la clinique pour la santé des animaux de compagnie; et communiquer le fait qu’un examen annuel est tout aussi important que l’amour et la nourriture. Ce programme ne remplace pas le programme de rappel actuel, mais lui sert en fait de complément.

Vous n’êtes pas encore convaincus? Durant 2015–2016, 1612 cliniques se sont inscrites au Programme de rappel pour les clients inactifs de PHP, ce qui a donné lieu à la réactivation d’une moyenne de 128 clients par clinique (dont beaucoup étaient absents depuis deux ou trois ans). Le programme a permis d’améliorer la santé des animaux de compagnie et des cliniques!

Le fait que ce programme soit incroyablement facile à utiliser représente un autre avantage certain car il n’est pas nécessaire de former les employés ni d’apporter des changements aux protocoles de l’équipe de la clinique. Vous n’avez qu’à affecter un ou deux employés à l’identification des clients inactifs et le reste du travail s’effectuera en trois étapes faciles!

**ÉTAPE 1 :** Identifier les clients inactifs.

**ÉTAPE 2 :** Envoyer un courriel aux clients en utilisant la méthode éprouvée des messages compatisants prêts à utiliser de PHP.

**ÉTAPE 3 :** Commencez à prendre des rendez-vous!

Pour commencer, allez sur le site Web de Partners for Healthy Pets (www.partnersforhealthypets.org/inactive_client_program.aspx) et examinez les ressources facilement accessibles qui sont fournies : Un exemplaire du livre blanc du Programme de rappel des clients inactifs (Inactive Client Reminder Program); un webinaire qui explique les succès et les résultats éprouvés du programme; et les modèles de courriels faciles à utiliser grâce aux communications uniques et éprouvées de PHP avec les propriétaires d’animaux.

L’ACMV est excitée de vous offrir cette occasion à vous et à votre clinique. C’est aussi facile que 1, 2, 3!
The CVMA’s Emerging Leaders Program

The CVMA’s Emerging Leaders Program (ELP) started in 2010 as a small full-day workshop with the objective of supporting and developing leadership skills within Canadian veterinarians and to inspire leadership within the veterinary profession.

The CVMA’s Emerging Leaders Program was realized with the help of the provincial veterinary medical associations, and exclusive sponsor, Virox Animal Health. If you would like to learn more about the Emerging Leaders Program and how to participate please contact Sarah Cunningham (scunningham@cvma-acmv.org).

The spotlight on ELP series will highlight the experience of some past participants of the program. Let’s turn the spotlight on Dr. Beth Cozens.

1. Why did you want to participate in the CVMA’s ELP?

A challenge I face as a practice owner in my small hometown is being the employer of technicians who have been at the practice since it opened over 30 years ago and with whose children I attended grade school and high school. This dynamic can certainly become difficult. My team also faces a large generational divide, which poses different challenges. I wanted to attend the CVMA’s ELP in the hope of improving my leadership techniques regarding these challenges.

2. What was the highlight of the program for you?

A highlight of the program was participating in the CVMA pet obesity focus group. I find in day-to-day practice the conversations I have with owners regarding their pets’ weights and diets can become monotonous and sometimes defeating. Being part of developing a public education protocol regarding pet obesity felt very rewarding in that I was getting to effect the positive change I want to in a different way; outside of regular practice.

3. Describe one specific action that you are doing differently after participating in the ELP?

We have monthly team meetings that now carry greater importance than discussing specific issues that have come up since the last meeting. The meetings are viewed as a valuable use of our time, have a more open dialogue, and each time we re-focus on the core values and message statement we developed at our 1st meeting after I had attended the

Le Programme des futurs leaders de l’ACMV

Le Programme des futurs leaders (PFL) de l’ACMV a débuté en 2010 sous forme d’un atelier d’une journée dans le but d’appuyer et de développer les compétences de leadership parmi les vétérinaires canadiens et d’inspirer le leadership au sein de la profession vétérinaire.

Le Programmes des futurs leaders de l’ACMV a été mis en œuvre grâce à l’appui des associations provinciales de médecins vétérinaires et du commanditaire exclusif, Virox Animal Health. Si vous aimeriez en apprendre davantage à propos du Programme des futurs leaders et sur la façon d’y participer, veuillez contacter Sarah Cunningham, (scunningham@cvma-acmv.org).

La série Pleins feux sur le PFL soulignera l’expérience de quelques-uns des participants au programme. Présentons maintenant la Dve Beth Cozens.

1. Pourquoi désirez-vous participer au PFL de l’ACMV?

En tant que propriétaire de pratique, un défi que je dois relever dans ma petite localité est d’être l’employeur de techniciennes qui travaillent à la clinique depuis son ouverture il y a 30 ans et d’avoir fréquenté l’école secondaire et élémentaire avec leurs enfants. Cette dynamique peut parfois devenir difficile. Mon équipe doit aussi composer avec un grand écart générationnel, ce qui présente divers défis. Je voulais assister au PFL de l’ACMV dans l’espérance d’améliorer mes techniques de leadership à l’égard de ces défis.

2. Quel a été le fait saillant du programme pour vous?

Un fait saillant du programme a été la participation au groupe de discussion sur l’obésité des animaux de compagnie de l’ACMV. Je trouve que, dans la pratique quotidienne, les conversations que j’ai avec les propriétaires concernant le poids et la diète de leurs animaux de compagnie peuvent devenir monotones et parfois défaitistes. Il a été gratifiant de participer à l’élaboration d’un protocole d’éducation publique concernant l’obésité des animaux de compagnie car je réussissais à avoir un impact positif d’une manière différente, soit à l’extérieur de la pratique régulière.

3. Décrivez une action particulière que vous effectuez différemment après votre participation au PFL?

Nous avons des réunions mensuelles d’équipe qui revêtent maintenant une plus grande importance qu’une simple discussion des enjeux particuliers qui sont survenus depuis la dernière réunion. Les réunions sont considérées comme une bonne utilisation de notre temps, comportent plus de dialogues ouverts et, à chaque fois, nous nous rappelons nos valeurs fondamentales et l’énoncé de mission que nous avons établis à notre première réunion après ma participation au PFL. Un objectif principal de notre réunion consiste à assurer que nous travaillons toujours à l’amélioration et au maintien de la culture en milieu de travail au sein de laquelle nous désirons tous œuvrer.

4. Croyez-vous qu’il est important pour les autres participants à la collectivité vétérinaire de devenir plus actifs dans la formation au leadership? Pourquoi?

Je crois qu’il est extrêmement important pour les membres de la collectivité vétérinaire de devenir plus actifs dans la formation
Dr. Erin MacDonald Takes Over as PEI Representative

With Juanita Glencross-Winslow’s resignation from CVMA Council last spring, the Prince Edward Island Veterinary Medical Association (PEIVMA) has appointed Dr. Erin MacDonald to represent CVMA members in Prince Edward Island (PEI). Erin’s term will commence on January 1, 2019 and end on December 31, 2021.

Erin MacDonald grew up on beautiful Prince Edward Island. After earning her BSc from Mount Allison University in New Brunswick, she graduated from the Atlantic Veterinary College in Prince Edouard Island in 2007. Following graduation, she moved to Ottawa, Ontario to practice at a small animal clinic. Within a year, the Island was calling her back home and she was lucky enough to obtain a position at the Summerside Animal Hospital where she has been practicing small animal medicine for the last 10 years. In 2012 Erin was elected to serve on the PEIVMA Council and in November of 2014 became the president of the Association. After serving for 4 years she is excited to represent CVMA members in her province on the CVMA Council.

Erin is an avid reader and loves to take in continuing education wherever she can find it. In her time away from veterinary medicine she enjoys travel, gardening, working for Studio 30 Fitness Company, and baking.

ELP. A main goal of our meetings is to ensure we are always developing and maintaining the workplace culture in which we all wish to work.

4. Do you think it is important for others within the veterinary community to become more active in leadership training? Why?
I think it is extremely important for members of the veterinary community to become more active in leadership training as our industry automatically places us in positions of leadership in many ways. We are leaders to our technicians and tech assistants, to our co-op students, to our veterinary externship students, to our high school volunteers, to our clients, and to the members of our community. All of these groups of people would benefit from different styles of leadership. Leadership training helps us remember there is more to our job than just seeing appointments and performing procedures, and helps us focus on creating the culture we want ourselves and the people we lead to enjoy.
Special Report  Rapport spécial

*Haemaphysalis longicornis*: A tick of considerable veterinary importance, now established in North America

H. Joel Hutcheson, Shaun J. Dergousoff, L. Robbin Lindsay

*Haemaphysalis longicornis*, the “Asian longhorned tick” (ALT), is native to eastern Asia and has spread to Australia, New Zealand, and several Pacific islands, where it is a threat to the health and welfare of wild and domestic animals (1,2). This tick is now established in the United States. Large numbers of all active life stages were collected from sheep, humans, and vegetation on a ranch in Hunterdon County, New Jersey, in October 2017 (3). From April to September 2018, numerous ALTs were collected from vegetation, domestic animals, wildlife, and humans in 8 additional States (4). Retrospective examination of tick collections revealed that populations were present in New Jersey as early as 2013 (5). Fortunately, this tick has not been detected in Canada; this was confirmed through re-examination of *Haemaphysalis* species held in the Canadian National Collection, Ottawa (Wayne Knee, Canadian National Collection of Insects, Arachnids and Nematodes, personal communication, 2018).

Life history and biological traits of ALT promote its continued range expansion. Asian longhorned ticks are 3-host ticks, with larvae, nymphs, and adults feeding on separate individuals of a wide range of wild and domestic species (6), including birds, domestic animals, livestock, and humans. Once introduced into suitable habitats, ALT populations can build rapidly, partly because the strain introduced into the United States is parthenogenetic (3). Preliminary analyses of the potential geographic range in North America, based upon habitat suitability and the environmental requirements of *H. longicornis* in New Zealand (2), indicate a potential for ALTs to establish in parts of Quebec, Ontario, and Manitoba (7). Although these early models are imperfect, they serve as a warning that parts of Canada likely meet minimum criteria to support ALT populations.

Incursion and establishment of ALT populations in Canada represent risks to animal health/welfare because this species has been associated with several pathogens, including *Theileria orientalis* and 2 *Anaplasma* species (3,8). These ticks are also significant pests that can occur in large numbers; heavy infestations can lead to exsanguination (1). To date, pathogens have not been detected in ALTs collected in the United States; however, there is concern that this species may play a role in transmission of endemic tick-associated pathogens such as *Anaplasma, Babesia*, and *Theileria* species.

Early detection will be critical to implementation of suitable mitigation measures for minimizing risks associated with *H. longicornis*. Asian longhorned ticks are readily distinguished from species that commonly infest domestic animals and livestock in Canada, including the American dog tick (*Dermacentor variabilis*), Rocky Mountain wood tick (*Dermacentor andersonii*), and the blacklegged tick (*Ixodes scapularis*) (9). However, ALTs are difficult to differentiate morphologically from the 2 endemic *Haemaphysalis* species in Canada, particularly the larval and nymphal stages (6,9). Molecular methods may be required to confirm species identity (3). Endemic *Haemaphysalis* species typically occur on rabbits or birds, so the presence of *Haemaphysalis* ticks on other animals should raise suspicion, particularly when they occur in large numbers. To facilitate accurate tick identification, please contact your local/regional tick surveillance program or one of the authors, if you detect ticks on animals that are atypical or that you suspect may be ALTs.

References


Case Report Rapport de cas

Retained laser fiber in the nidus of a recurrent cystine urolith in an intact male English bulldog

Emmanuelle M. Butty, Anne-Sophie Bua, Nick P. Vanstone, Marilyn E. Dunn

Abstract — A lithotripsy and percutaneous cystolithotomy (PCCL) were performed on a 5-year-old intact male English bulldog. The composition of the uroliths was 100% cystine. When a second PCCL was performed 2 months later, the nidus of the largest urolith was a segment of an optical fiber broken off during laser lithotripsy.

Résumé — Fibre laser formant le nidus d’une urolithiase à cystine récurrente chez un Bulldog Anglais mâle entier. Une lithotripsie et une cystolithotomie percutanée (PCCL) ont été réalisées sur un Bulldog Anglais mâle entier de 5 ans. L’urolithé était constitué à 100 % de cystine. Lors d’une seconde PCCL réalisée 2 mois plus tard, le nidus du plus grand calcul de cystine se révéla être un fragment de fibre optique brisée durant la lithotripsie au laser.

A ny foreign material in the bladder can act as a nidus for stone formation, especially in a patient with risk factors for stone formation and having had previous uroliths. In human medicine, foreign bodies are a major cause of large urolith formation and are mainly secondary to broken equipment during endourologic procedures, including broken laser fibers, forgotten material during open transvesicular surgery, retained catheter tips, or sutures from bladder surgery (1–4). In veterinary medicine, sutures are the most common cause of iatrogenic cystolith formation, being the cause of 0.6% of canine uroliths and 9.4% of recurrent canine uroliths (5). In 2 case reports, a sewing needle in 1 dog and a mouse barley awn (Hordeum murinum) in 2 dogs were found to be the nidus of struvite uroliths likely formed secondary to infection caused by the foreign material (6,7).

Case description

A 5-year-old male intact English bulldog was presented for episodes of hematuria and dysuria. Prior to his presentation, cystine crystals were observed in the urine sediment and radiographs had shown multiple poorly radiopaque bladder and urethral stones. Retrograde urohydropulsion failed to retro-pulse the urethral stones into the bladder. The dog was referred to our internal medicine service for further evaluation and treatment.

A lateral abdominal radiograph showed at least 11 poorly radiopaque bladder stones with a smooth contour varying in size from 1.4 to 6.4 mm and 10 urethral stones varying in size from 1.8 to 5.7 mm in diameter. It was decided that retrograde cystoscopy and lithotripsy would be attempted. If unsuccessful, a percutaneous cystolithotomy (PCCL) would be performed. Considering the probability of androgen-dependent cystinuria, castration was recommended but declined.

A flexible ureteroscope (FLEX-X 11278/VSU Flexible ureteroscope; Karl Storz Endoscopy, Culver City, California, USA) was advanced in a retrograde direction into the penile urethra under continuous saline irrigation. Multiple stones, partially obstructing the urethra and embedded within the mucosa were identified. A laser fiber [365-μm Holmium (H-30) YAG laser fiber and 30-W Hol:YAG lithotrite; Convergent, Alameda, California, USA] was inserted through the working channel of the ureteroscope until it came into contact with the stones. The stones were fragmented using a low powered holmium:yag (Ho:YAG) laser (Medical-Holmium Laser, Model HL-30; Cook Medical, Bloomington, Indiana, USA) at the following settings: 10 Hz and 0.8 J at a pulse width of 350 ms. Stone fragments were removed using a stone retrieval basket (NCompass Nitinol Stone extractor 2.4 Fr x 115 cm; Cook Medical). Following removal of half of the urethral stones, the urethral mucosa became increasingly edematous and visibility had decreased.

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As there were also multiple bladder stones to be removed, it was deemed best to remove the remaining stones by PCCL. A 2-cm ventral midline skin incision and a 1.5-cm incision through the linea alba preceded a stab incision into the bladder lumen between 3 stay sutures. A 6-mm laparoscopic screw-tip trocar (Trocar, 5.5 mm inner diameter; Richard Wolf, Vernon Hills, Illinois, USA) was advanced into the bladder lumen and a rigid 10.5 Fr cystoscope (Rigid endoscope, 3.5 mm with a 10.5-Fr sheath, 30° lens; Richard Wolf) was inserted. Bladder stones were removed with a stone retrieval basket (NCompass Nitinol Stone extractor 2,4 Fr x 115 cm; Cook Medical) passed through the working channel of the cystoscope. The urethra was evaluated with a flexible ureteroscope (FLEX-X 11278/VSU Flexible ureteroscope; Karl Storz Endoscopy) passed through the trocar. Large embedded stones in the penile urethra were fragmented using the laser passed through the channel of the ureteroscope and retrieved with a stone basket (NCircle Nitinol Tipless Stone Extractor, 2,2 Fr x 115 cm; Cook Medical) in an antegrade manner.

At the end of the procedure, the entire lower urinary tract was inspected and no stone fragments remained. The urethral mucosa showed focal erosions and edema at the site at which the stones were embedded. Quantitative bladder stone analysis was performed at the Canadian Veterinary Urolith Centre at the University of Guelph. Using light microscopy combined with crystallographic techniques and scanning electron microscopy with X-ray microanalysis, the uroliths were confirmed to be 100% cystine (stone and shell). Type III androgen-dependent cystinuria was suspected. The owner declined submission of urine samples to the School of Veterinary Medicine at University of Pennsylvania, Section of Medical Genetics for qualitative analysis of the urine amino acids cystine, ornithine, lysine, and arginine (COLA).

Two months later, the dog was presented with a new episode of dysuria. Radiographs showed multiple radiopaque bladder and urethral stones. The dog had been exclusively fed a cystine and methionine-restricted diet (Veterinary Diet Urinary UC Low Purine Dry Dog Food; Royal Canin, Puslinch, Ontario). A second PCCL with a rigid cystoscope (Rigid endoscope, 3.5 mm with a 10.5-Fr sheath, 30° lens; Richard Wolf) and stone basket (NCircle Nitinol Tipless Stone Extractor, 2,2 Fr x 115 cm; Cook Medical) was performed as previously described and the dog was neutered. Stones in the urethra were partially obstructive and embedded within the mucosa. Proliferative polypoid-like structures reducing the urethral lumen were visible in the distal urethra, at the site of the previous urethroliths. The stones were sent to the Canadian Veterinary Urolith Centre and the nidus of the largest urolith appeared to be a clear cylindrical rod. An image of the urolith containing the rod and a higher magnification image of the rod are shown in Figures 1 and 2. The material from the core and the coating of the rod was analyzed in a scanning electron microscope equipped with an X-ray microanalysis system (JEOL JSM-6010LA scanning electron microscope with attached energy dispersive spectrometer (EDS); Jeol USA, Peabody, Massachusetts, USA) to determine elemental compositions. The X-ray spectra for the core and the outer coating of the rod are shown in Figures 3 and 4.

The core was primarily composed of silicon and oxygen, suggesting Quartz (silica). The coating was found to be primarily composed of carbon and fluorine, typical of a number of fluoropolymers. It was determined to most likely be a segment of an optical fiber broken off in the urinary tract during lithotripsy. The remainder of the urolith (stone and surface) was confirmed to be composed of 100% cystine.

One month after the dog had been neutered, a colorimetric cyanide-nitroprusside test on urine sent to the University of Pennsylvania, Section of Medical Genetics, was negative. The restricted diet (Veterinary Diet Urinary UC Low Purine Dry Dog Food; Royal Canin) was discontinued. One year later, the dog had not shown any lower urinary tract signs. He is fed a low caloric diet (Veterinary Diet Weight Control Dry Dog Food; Royal Canin) and the colorimetric cyanide-nitroprusside test on urine remains negative.

Discussion

To our knowledge, this is the first report of a laser fiber, likely broken off in the urinary tract during previous lithotripsy, to be in the nidus of a urolith in a veterinary patient. In this report,
the dog had risk factors for stone formation and stone recurrence was primarily due to persistent cystinuria and not solely secondary to the fiber foreign body as multiple stones recurred and the laser fiber was only identified in one of the stones retrieved. Cystinuria is an inherited transport dysfunction of the amino acids cystine, ornithine, lysine, and arginine (8). While cystinuria has been described in more than 70 dog breeds (9), recent studies have described the genetics of cystine transport dysfunction. More recently, a new classification has been published (10) with autosomal recessive (type I), dominant (type II), and a type III or androgen dependent cystinuria. While the exact gene mutation has yet to be established, type III affects mature males. Castration is known to result in correction of the underlying tubular defect in mastiffs, Scottish deerhounds, and Irish terriers (8). The dog in our report had stone recurrence despite exclusively eating a cystine and methionine restricted diet. Type III cystinuria is highly suspected since 4 wk (while on a restricted cystine diet) and 1 year (while on a regular maintenance diet) after neutering, the nitroprusside test remained negative.

Laser fiber fracture has been reported in the human literature (1–3,11–13). In our patient, a short pulse width was used for fragmentation to allow removal of stone fragments and avoid excess stone dust. Despite the low energy and low frequency used to decrease the risk of fiber fracture as previously reported (12), the authors believe that this patient was at increased risk of fiber fracture during lithotripsy because of 2 factors. First, the bending of the scope and therefore the fiber to navigate the penile and pelvic urethra (smaller bending radius) likely contributed to an increased fracture risk (11–13). Second, lithotripsy was done in the urethra and despite continuous saline flush, this restricted liquid environment may also have increased the risk of fiber damage, as the Ho:YAG laser is a pulsed type of laser that emits energy absorbed by the water (14). Given the increasing awareness and recommendations for alternative, non-invasive methodologies for urolith removal (15), this complication may occur more frequently in the future. To avoid this type of complication, the authors recommend a thorough examination of the laser fiber (entire length and tip) before and after each procedure in the following manner. The laser aiming beam (visible light) should be first activated to inspect the entire length of the fiber. The working beam is coincident with the aiming beam and breaks will appear as bright as the laser aiming beam. With a minimum magnification (loupe or video system), the user should inspect the output tip for pits, cracks, and chips. The fiber is finally checked using the aiming beam output (optical fiber spot check) about 5 cm from a light surface. The tip spot shape is acceptable if the spot appears as a perfect uniform circle with a dark center and sometimes a light halo. A circle with a thick halo, a spot with comet tail extending from one edge or any other changes are deemed unacceptable.

Figure 3. X-ray spectrum for the core of the rod protruding from the urolith.

Figure 4. X-ray spectrum of the coating on the rod protruding from the urolith.
Finally, a copious flush of the entire urinary tract system and a final inspection with the endoscope is recommended at the end of each procedure. Laser fiber bending occurs less with a percutaneous cystolithotomy approach and this approach may be associated with a lower fracture rate.

In conclusion, a segment of laser fiber, likely broken off in the urinary tract during cystoscopy and lithotripsy was found to be the nidus of a cystine urolith. To the authors’ knowledge, this is the first reported case of a laser fiber as the nidus of a stone in a veterinary patient. As lithotripsy is being performed more and more in companion animals, it is imperative to take measures to ensure laser fiber integrity and early recognition when a fiber breaks.

Acknowledgments

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References

Clinical and immunophenotypic findings in 4 forms of equine lymphoma

Arianna Miglio, Chiara Morelli, Rodolfo Gialletti, Eleonora Lauteri, Monica Sforna, Maria Luisa Marenzoni, Maria Teresa Antognoni

**Abstract** — The clinical, histological, and immunophenotypic findings are presented for 4 horses affected by different types of lymphoma. Diagnoses of a monomorphic epitheliotropic intestinal T-cell lymphoma, a diffuse splenic large B-cell lymphoma, a peripheral T-cell lymphoma, and a T-cell rich large B-cell lymphoma of the third eyelid were made.

**Horse 1**
A 26-year-old Italian Saddle horse gelding was treated for colic at the Veterinary Teaching Hospital of Perugia (OVUD-UNIPG). The gelding had a 7-day history of diarrhea and lack of appetite. Fluid and antispasmodic drugs had previously been administered by the referring veterinarian, but after 3 d, the symptoms resumed.

On presentation, the horse appeared depressed, with a body condition score (BCS) of 8/9. The vital parameters were outside the normal limits: heart rate: 88 beats/min [reference interval (RI): 25 to 40 beats/min]; respiratory rate: 40 breaths/min (RI: 8 to 16 breaths/min); and serum lactate 4.1 mmol/L [reference value (RV), 2 mmol/L]. The feces contained stones.

Abdominal ultrasonography (LOGIQ C5 Premium; GE Healthcare, Jakarta Selatan, Indonesia) was performed using a 7.5 MHz probe: a large amount of anechoic peritoneal fluid was found especially in the caudal aspect of the abdomen. The stomach was distended until the 15th intercostal space, and the walls of both the small and large intestine were thickened (colonic vessels were seen). An exploratory laparotomy was carried out under general anesthesia. Thickness of the ileum, pelvic flexure, and enlargement of mesenteric lymph nodes were found during surgery. Full thickness biopsy samples of the pelvic flexure and lymph nodes were collected (Figure 1).

The gelding received supportive care with constant rate infusion of lidocaine 2% (Lidocaina 2%; A.T.I. s.r.l, Ozzano dell’Emilia Bologna, Italy), 0.05 mL/kg BW/min, and Ringer’s lactate solution IV (Ringer’s Lactate S.A.L.F; S.A.L.F S.p.a, Cenate Sotto, Bergamo, Italy), 0.5 mL/kg BW/h, for 48 h after surgery. Benzylpenicillin procaine (Depocillina; MSD Animal Health srl, Happyfarma, Vicenza, Italy), 4 mg/kg body weight (BW), IM, and flunixin meglumine (Flogend; Intervet Productions Srl, Happyfarma, Vicenza, Italy), 1.1 mg/kg BW, IV, were administered for 7 d after surgery.

During hospitalization a nasogastric tube was inserted many times because of gastric reflux due to post-operative paralytic ileum. Hot and painful edema of the forelimbs appeared. Complete blood (cell) count (CBC) (Sysmex-XT 1800 vet; DASIT S.P.A. Cornaredo Milano, Italy), serum biochemistry...
Table 1. Hematological and biochemical findings in 4 horses with lymphoma.

<table>
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<tr>
<th>Parameters</th>
<th>Horse 1</th>
<th>Horse 2</th>
<th>Horse 3</th>
<th>Horse 4</th>
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<td>130.0</td>
<td>134.0</td>
<td>120 to 180</td>
</tr>
<tr>
<td>MCV (FL)</td>
<td>49.3</td>
<td>47.9</td>
<td>42.0</td>
<td>37.9</td>
<td>34 to 58</td>
</tr>
<tr>
<td>MCH (pg)</td>
<td>18.9</td>
<td>19.2</td>
<td>16.0</td>
<td>15.0</td>
<td>10 to 18</td>
</tr>
<tr>
<td>MCHC (g/L)</td>
<td>383.0</td>
<td>400.0</td>
<td>380.0</td>
<td>395.0</td>
<td>320 to 380</td>
</tr>
<tr>
<td>RDW (%)</td>
<td>22.4</td>
<td>22.7</td>
<td>23.0</td>
<td>26.4</td>
<td>12 to 16</td>
</tr>
<tr>
<td>PLT (10⁹/L)</td>
<td>114.0</td>
<td>251.0</td>
<td>220.0</td>
<td>131.0</td>
<td>100 to 400</td>
</tr>
<tr>
<td>MPV (FL)</td>
<td>8.1</td>
<td>7.8</td>
<td>6.6</td>
<td>NA</td>
<td>6 to 11</td>
</tr>
<tr>
<td>PCT (10⁹/L)</td>
<td>0.09</td>
<td>0.2</td>
<td>0.14</td>
<td>NA</td>
<td>0.05 to 0.22</td>
</tr>
<tr>
<td>WBC (10⁹/L)</td>
<td>5.74</td>
<td>13.52</td>
<td>9.96</td>
<td>9.93</td>
<td>5.5 to 16</td>
</tr>
<tr>
<td>NEU (%)</td>
<td>52.5</td>
<td>73.7</td>
<td>77.5</td>
<td>72.0</td>
<td>35 to 75</td>
</tr>
<tr>
<td>LYMPH (%)</td>
<td>41.5</td>
<td>18.8</td>
<td>17.3</td>
<td>23.0</td>
<td>25 to 45</td>
</tr>
<tr>
<td>MONO (%)</td>
<td>4.9</td>
<td>6.5</td>
<td>4.2</td>
<td>5.0</td>
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</tr>
<tr>
<td>EOS (%)</td>
<td>0.9</td>
<td>0.6</td>
<td>0.6</td>
<td>1.1</td>
<td>&lt; 4</td>
</tr>
<tr>
<td>BAS (%)</td>
<td>0.2</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>&lt; 1</td>
</tr>
<tr>
<td>TP (g/L)</td>
<td>66.0</td>
<td>96.0</td>
<td>75.0</td>
<td>62.0</td>
<td>55 to 75</td>
</tr>
<tr>
<td>TOT BIL (µmol/L)</td>
<td>82.08</td>
<td>24,282.0</td>
<td>42.75</td>
<td>48,393.0</td>
<td>8.55 to 47.88</td>
</tr>
<tr>
<td>LDH (U/L)</td>
<td>1386.0</td>
<td>580.0</td>
<td>850.0</td>
<td>1545.0</td>
<td>&lt; 400</td>
</tr>
<tr>
<td>GOT (U/L)</td>
<td>433.0</td>
<td>194.0</td>
<td>200.0</td>
<td>261.0</td>
<td>&lt; 240</td>
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<tr>
<td>ALP (U/L)</td>
<td>923.0</td>
<td>971.0</td>
<td>180.0</td>
<td>301.0</td>
<td>&lt; 240</td>
</tr>
<tr>
<td>CK (U/L)</td>
<td>429.7</td>
<td>129.0</td>
<td>44.0</td>
<td>241.7</td>
<td>&lt; 55</td>
</tr>
<tr>
<td>FIB (g/L)</td>
<td>18.7</td>
<td>32.0</td>
<td>10.4</td>
<td>9.52</td>
<td>1 to 4</td>
</tr>
<tr>
<td>SAA (mg/L)</td>
<td>492.07</td>
<td>10.3</td>
<td>32.0</td>
<td>27.86</td>
<td>0.5 to 20</td>
</tr>
<tr>
<td>A/G (g/L)</td>
<td>NA</td>
<td>5.3</td>
<td>0.66</td>
<td>NA</td>
<td>9.3 to 16.5</td>
</tr>
<tr>
<td>α-1-globulin (g/L)</td>
<td>NA</td>
<td>2.0</td>
<td>1.2</td>
<td>NA</td>
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<tr>
<td>α-2-globulin (g/L)</td>
<td>NA</td>
<td>15.2</td>
<td>8.3</td>
<td>NA</td>
<td>5 to 9</td>
</tr>
<tr>
<td>β-globulin (g/L)</td>
<td>NA</td>
<td>28.7</td>
<td>12.2</td>
<td>NA</td>
<td>5 to 13</td>
</tr>
<tr>
<td>γ-globulin (g/L)</td>
<td>NA</td>
<td>17.0</td>
<td>23.5</td>
<td>NA</td>
<td>6 to 13</td>
</tr>
<tr>
<td>Ca²⁺ (mmol/L)</td>
<td>NA</td>
<td>2.92</td>
<td>NA</td>
<td>NA</td>
<td>2–3 to 24</td>
</tr>
</tbody>
</table>

RBC — red blood cell; HGB — hemoglobin; HCT — hematocrit; MCV — mean corpuscular volume; MCH — mean corpuscular hemoglobin; MCHC — mean corpuscular hemoglobin concentration; RDW — red cell distribution width; PLT — platelet; MPV — mean platelet volume; PCT — plateletcrit; WBC — white blood cell; NEU — neutrophil; LYMPH — lymphocytes; MONO — monocytes; EOS — eosinophils; BAS — basophil; TP — total protein; TOT BIL — total bilirubin; LDH — lactate dehydrogenase; GOT — glutamic oxaloacetic transaminase; ALP — alkaline phosphatase; CK — creatine kinase; FIB — fibrinogen; SAA — serum amyloid-A; A/G — albumin/globulin ratio; NA — not available.

(Hitachi 904 Automatic Analyzer; Roche Diagnostics, S.P.A., Monza, Italy) and concentrations of serum amyloid-A (SAA) and fibrinogen (FIB) (Equinostic EVA1; Sandhold ID, Copenhagen, Denmark) were determined. Biochemical examination revealed an increase in lactate dehydrogenase (LDH), glutamic oxaloacetic transaminase (GOT), and creatine kinase (CK). In addition, SAA and FIB concentrations were elevated (Table 1).

Histologic examination of intestinal biopsy samples showed a severe and diffuse infiltration of monomorphic large and atypical lymphocytes, with round or slightly irregular nuclei, distributed within the epithelium and with involvement of submucosal layers. The results indicated a necrotic-hemorrhagic inflammatory process involving the mucosa, lamina propria, and muscular layers, as evidenced by a high number of neutrophils and a low number of eosinophils, which were admixed with fibrin and associated with thrombi of small arterioles, surrounded by lymphocytes, plasma cells and macrophages. Anisocytosis and anisokaryosis were moderate. Mitotic count (MC), determined by counting mitotic figures in 10 consecutive high-power fields (HPF), was 6/10HPF (Figure 2).

Histologic examination of mesenteric lymph nodes indicated chronic necrotic-hemorrhagic lymphadenitis with evidence of infiltration by a population of homogeneous lymphoid cells associated with increased mitotic activity; rare plasma cells were also observed. Immunohistochemistry (IHC) of the intestine and lymph node tissue with antibodies against CD3 (Dako, 1:200; Agilent, Santa Clara, California, USA) and CD20 (Thermo Scientific, 1:200; Thermo Fisher Scientific, Rodano Milano, Italy) antigens was performed (Figure 2). Most of the lymphoid cells present were CD3-positive (T-cells).

DNA was extracted from paraffin-embedded intestinal biopsy samples according to the manufacturer’s instructions (QIAamp DNA FFPE Tissue Kit; Qiagen, PrecisionMed. Solana Beach California, USA). A semi-nested polymerase chain reaction (PCR) protocol targeting a conserved fragment of glycoprotein B (gB) of Equid Herpesvirus type 5 (EHV-5) was performed (1), and the results from the intestine were positive.

Based on histology and IHC, a monomorphic epitheliotropic intestinal T-cell lymphoma (MEITL) was diagnosed according to the revised World Health Organization (WHO) criteria (2), and the lymph nodes were considered metastatic. The MC indicated indolent lymphoma.

The horse’s condition worsened because of paralytic ileum and the gelding was euthanized. The owner did not allow necropsy.
Horse 2

A 13-year-old Hirsh gelding horse was referred to the OVUD-UNIPG with a 3-month history of weight loss, depression, and polyuria/polydipsia. Serologic tests performed by the RV for Babesia caballi, Theileria equi, Leptospira bratislava, L. canicola, L. copenhageni, L. Grippothyphosa, L. hardjo, L. icterohaemorrhagiae, L. pomona, L. Saxkoebing, and L. Tarassovi were negative.

A blood test for adrenocorticotropic hormone (ACTH) revealed a high level of this hormone in the month of June (212 pg/mL between November and July, RV: 29 pg/mL) and in the month of October (66 pg/mL between August and October, RV: 47 pg/mL); thus a diagnosis of Cushing syndrome was made, and pergolide mesylate (Prascend; Boehringer Ingelheim Pty, Animal Health Division, Australia), 1 mg/kg BW, PO, was prescribed.

On presentation, the horse was lethargic, with a BCS of 4/9 and slightly hyperemic mucous membranes; the vital parameters were within normal limits. Abdominal ultrasonography detected a large well-defined splenic mass with heterogeneous echogenicity. Palpation per rectum revealed an abnormal location of the spleen in the middle of the abdominal cavity; the mass could not be palpated. No abnormalities were detected during ultrasonography of the thorax.

Fine-needle aspiration (FNA) and biopsies of the splenic mass and bone marrow were performed with the horse in standing sedation with detomidine hydrochloride (Domidine; Fatro Spa, Ozzano dell’Emilia Bologna, Italy), 10 μg/kg BW, IV. During hospitalization, the horse experienced colic and weight loss despite a good diet.

Serum biochemistry and CBC indicated normocytic normochromic anemia, and elevated LDH, alkaline phosphatase (ALP), and total protein (TP). A blood smear revealed reactive/atypical lymphocytes (1%) and rare erythroblasts. Electrophoresis of serum proteins showed a decreased albumin/globulin ratio and increased α₂, β- and γ-globulins (Table 1).

The bone marrow cytology was normal, but cytological evaluation of the spleen revealed blood contamination and marked cellularity characterized by medium-sized lymphoblasts, small lymphocytes, and macrophages with erythrophagocytosis. Histological evaluation of the spleen revealed a population of large round cells with a low nuclei/cytoplasm ratio, and ovoid-round nuclei with irregularly thickened chromatin and 1 visible nucleolus. Anisocytosis and anisokaryosis were evident, and the MC was 8/10 HPF (Figure 3).

Immunohistochemistry of the splenic tissue with antibodies against CD3 and CD20 antigens was performed. Most of the lymphoid cells were CD20+ (B-cells) (Figure 4). Flow cytometry (FC) (BD Accuri C6; BD Biosciences, Milan, Italy) of the splenic mass, peripheral blood, and bone marrow was conducted for the following: CD4 (T-cell; CVS4 BioRad, Clinical Diagnostics BioRad, Milan, Italy), CD21 (B-cell; CA2.1D6 BioRad), cyCD3 (T-cell; CD3-12 BioRad), and cyCD79a (B-cell; HM57 BioRad). The spleen sample was cyCD79a+ (64%) and CD21+ (41%), whereas the peripheral blood and
the bone marrow blood were CD21+ (0.1% and 0.2%, respectively). The PCR for EHV-5 from paraffin-embedded spleen samples was positive.

The cytological, histological, IHC, and FC results suggested a diagnosis of diffuse large B-cell lymphoma (DLBCL) of the spleen according to the revised WHO (2016) classification (2). The MC indicated mid-grade lymphoma. At the request of the owner, the horse was discharged, but died several days later. The owner did not allow necropsy.

Horse 3
A 12-year-old pony mare was presented to the OVUD-UNIPG with a 5-month history of tear duct obstruction as well as third eyelid prominence and a 1-month history of mandibular lymph node enlargement. On thoracic auscultation, crackles were heard. Acetylcysteine, sodic cefazolin, and flunixin meglumine therapy was started by the referring veterinarian (dosage unknown). No improvement was seen. Edema of the nasal meatuses and laryngeal collapse were found by the referring veterinarian during an endoscopic examination of the primary airways. One month before the hospitalization dexamethasone was administered to the mare (dosage unknown) for 3 d; this resulted in improvement in the respiratory signs but not the ophthalmic signs.

On presentation, the mare had pale mucous membranes, right serous ocular discharge, enlarged mandibular lymph nodes, and a BCS of 7/9. Respiratory tract evaluation indicated hyperemia of the nasal mucosa and muco-purulent discharge from the left nostril; traction on the trachea elicited a dry and deep cough. A respiratory bag test indicated the auscultation of a reinforced breath sound over the cranial-ventral parts of the thorax. Thoracic ultrasonography showed comet tails in the ventral quadrant, but the findings were considered unremarkable. Thoracic latero-lateral X-rays revealed a round radiopaque zone in the throat region. Fine-needle aspiration of the mandibular lymph nodes was carried out. Endoscopic examination of the primary airways showed enlargement of the sampled pharyngeal lymphoid tissue. Third eyelid resection was carried out on the horse in standing sedation with detomidine hydrochloride (Domidine), 0.04 mg/kg BW, IV, and the tissue was sampled. Benzylpenicillin procaine (Depocillina), 4 mg/kg BW, IM and flunixin meglumine (Flogend), 1.1 mg/kg BW, IV treatments were administered for 7 d after the surgery. Chloramphenicol, colistimethate sodium rokitetracycline (Colbiocin; SIFI S.P.A., Bologna, Italy) and chloramphenicol and betamethasone (Betabioptal; Farmila Theà, Milan, Italy) eye drops were administered.

The serum biochemistry and CBC revealed normochromic normocytic anemia and elevated concentrations of LDH, FIB, and SAA. Electrophoresis of serum proteins showed a decreased albumin/globulin ratio due to an increase in γ-globulins and a decrease in α1-globulins (Table 1). Cytological evaluation of the lymph nodes revealed a mixed population of small and medium lymphocytes, numerous macrophages, and giant multinucleated cells, which contained rod-shaped bacteria.

Histological examination of the eyelid tissue showed severe infiltration by a mixed population of cells composed predominantly of numerous small lymphocytes and fewer large round cells (2 or 3 times the size of red blood cells) with little eosinophilic cytoplasm, ovoid nuclei with irregularly coarse chromatin and 1 or more nucleoli, which were referred to as lymphoid cells. These lymphocytes widely infiltrated the epithelium of the eyelid and the surgical margins. Anisocytosis and anisokaryosis were moderate. The MC was 11/10 HPF (Figure 5). The IHC with anti-CD3, and anti-CD20 antibodies indicated CD3 positivity of atypical cells (Figure 6). Histological examination of the pharyngeal sample was characterized by hyperplasia of the associated lymphoid tissue. Bacterial culture of the lymph nodes was negative. The PCR for EHV-5 from paraffin-embedded biopsy samples of the pharynx and eyelid tissues was positive.

The revised WHO classification (2), the histological findings, and the IHC results supported a diagnosis of peripheral T-cell lymphoma (PTCL) of the third eyelid associated with granulomatous lymphadenitis of the mandibular lymph nodes (2). The MC indicated high grade lymphoma. The animal was discharged upon the owner’s request but died after 2 wk. The owner did not allow necropsy.
Horse 4
A 7-year-old Italian Saddle mare was presented to the OVUD-UNIPG with a 6-month history of right ocular discharge, hyperemia, and prominence of the third eyelids. On presentation, the mare was in good body condition (BCS 8/9). The vital parameters were within normal limits. The third eyelids, however, were hyperemic, edematous, and protruding, and the mandibular lymph nodes were enlarged. Ophthalmological ultrasonography was performed using orbital, frontal, and palpebral nerve blocks with 5 mL of lidocaine 2% (Lidocaina 2%) for each eye, but no abnormalities were found. Thoracic ultrasonography showed comet tails, but the data were considered unremarkable.

Both third eyelids were removed from the horse in standing sedation with detomidine hydrochloride (Domidine), 10 mg/kg BW, IV, and butorphanol (Dolorex; MSD Animal Health srl), 0.04 mg/kg BW, IV. Histological analysis and FNA of the mandibular lymph node were performed. Benzylpenicillin procaine (Depocillina), 4 mg/kg BW, IM, and flunixin meglumine (Flogend), 1.1 mg/kg BW, IV, treatments were administered for 7 d after the surgery.

Serum biochemistry showed an increase in LDH, SAA, and FIB (Table 1). Microscopic evaluation of a peripheral blood smear indicated atypical/reactive lymphocytes (2%). Histological evaluation of the third eyelid showed a hypercellular, poorly delineated, encapsulated proliferation of round cells that infiltrated the tear glands and the fat tissue. These cells were characterized by little basophilic cytoplasm, round indented nuclei with coarse chromatin and poorly defined nucleoli, and numerous small cells surrounding the large cell. Anisocytosis and anisokaryosis were moderate. The MC was 7/10 HPF; rare macrophages, plasma cells and giant multinucleated cells were also seen. The IHC results for CD3 (T-cell) and CD20 (B-cell) were positive for both antigens (Figures 7, 8). The results of FNA of the mandibular lymph nodes were characterized by small lymphocytes (75%), macrophages (15%), giant multinucleated cells (7%), and plasma cells (3%).

Flow cytometry was performed on the third eyelid and on the mandibular lymph node with a restricted panel of antibodies to the following: CD18 (granulocytes; CVS9 BioRad, Clinical Diagnostics BioRad, Milan, Italy), CD4 (T-cell), CD21 (B-cell) and cyCD3 (T-cell). The third eyelid was characterized by a population of large CD18+ cells (65%). Lymphocytes represented 25% of the cell population; the CD3+ and CD4+ cells accounted for 16.9% and 12.2%, respectively. The lymph node sample showed a mixed population with a majority of small cells CD18+ (91%). The cells were mostly cyCD3+ (78%), and fewer were CD4+ (24%) and CD4 (54%). The remaining population (9%) was composed of large CD18+ cells that were partly cyCD3 (9%), partly CD4+ (4%) and CD4− (5%).

The histological and IHC results of the third eyelid were suggestive of TCRLBCL according to the revised WHO classification (2). Flow cytometry of the third eyelid indicated a mixed inflammatory infiltrate. The mean mitotic index indicated mid-grade lymphoma. The FNA results for the lymph nodes showed chronic (macrophage) inflammation, whereas FC indicated a reactive lymph node owing to the presence of different cell populations. The use of a restricted panel of antibodies did not allow for complete analysis. After the surgery, the mare was affected by viral keratitis, which was treated with ganciclovir (Virgan; Farmila Theà, Milan, Italy) and tobramycin (Tobral; Alcon S.P.A, Milan, Italy) eye drops.

After 2 y, the mare is still alive, and there is no evidence of recurrence.

Discussion
Lymphoma is the most common hematopoietic neoplasia in horses (3). Clinical findings such as weight loss, fever, inapetence, lymphadenopathy, ventral edema, swelling of the limbs, and colic are nonspecific and vary according to the organ involved. No gender, breed, or age predispositions have been found, and there are no known etiological agents (4).

Based on the anatomic site, lymphoma can be divided into multicentric (generalized), alimentary (intestinal), mediastinal (thymic), cutaneous, and solitary/atypical (i.e., spleen, palate, nasopharynx, and extraocular) forms. The multicentric form is
Alimentary lymphoma is the most frequent intestinal neoplasm in horses (3,6). As in our case (Horse 1, 26-year-old), elderly animals are generally affected by this form of lymphoma (13,18–20). The horse showed diarrhea and increased peritoneal fluid, which are commonly seen in horses with alimentary lymphoma; however, the horse did not show protein loss enteropathy, as has been frequently reported in the course of intestinal lymphoma (19–23). Most cases of alimentary lymphoma in horses have a postmortem diagnosis; in our case, an exploratory laparotomy provided an antemortem diagnosis. Thus, the surgical approach seems to be the best procedure for diagnosis of this kind of lymphoma (13,17,18–21). Histologically, there was a diffuse infiltration of the mucosa, as typically reported in young horses; in contrast, the presence of a well-defined intestinal mass is more frequently reported in older horses (17,18). Histological and IHC investigation supported a diagnosis of MEITL, based on the revised WHO classification (2). Previously, MEITL was known as a variant (type II) of the enteropathy-associated T-cell lymphoma-EATCL. The EATCL is an intestinal neoplasm characterized by T-epitheliotropic cells, diffuse infiltration, and diffuse ulceration of the mucosa, owing to TIA-1 cytotoxic granules contained in cytotoxic T-lymphocytes. This disease is divided into type I, which shows a polymorphic cellular composition and is closely linked to celiac disease (now simply designated as enteropathy associated T-cell lymphoma/EATCL), and type II, which is not associated with celiac disease (now formally designated as monomorphic epitheliotropic intestinal T-cell lymphoma/MEITL). To our knowledge this is the first case of MEITL described in horses (19,22,24,25). This anatomical location has been found to have poor outcomes and the T phenotype is more aggressive; in fact, the horse's state rapidly worsened. Exploratory laparotomy confirmed that both the small and large intestine were affected by the disease, as described in other cases, although the small intestine has been reported to be involved more frequently than the large intestine (6,13,23). The surgery allowed us to sample a mesenteric lymph node, which was characterized by the presence of neoplastic lymphocytes. The infiltration of only mesenteric lymph nodes is commonly seen in alimentary lymphoma and is considered a metastatic infiltration (21,23).

Horse 2 was affected by primary splenic diffuse large B-cell lymphoma which is rarely reported in human or veterinary medicine (25–27). To our knowledge, there is only 1 case that has been well-described in the horse. Generally, splenic involvement is linked to a multicentric form, and the spleen is characterized by multifocal/diffuse nodules (28,29). In our case, the spleen was affected by a well-defined solitary mass, and other organs did not show evidence of neoplasia; therefore, a solitary/atypical form of DLBCL was diagnosed. As in other cases (28,29), no significant clinical abnormalities were identified in our case, despite the large solitary splenic mass. Unfortunately, we could not define the size of the splenic mass because necropsy was not allowed. Histologically, the splenic mass was characterized by large lymphoid cells in both the present case and a previously reported case (25). In human medicine, DLBCL is a rare neoplasm (2% of non-Hodgkin lymphomas) known as Primary Malignant Lymphoma of the Spleen (PMLS) (27).
characterized by small lymphocytes and large cells or mixed cell type, and mostly of the B phenotype. In contrast, large cells were identified in our case and a previously described case (25). Both in our case and in the case described by Tanimoto et al (25), the phenotype is B, even though in the latter, the cell type was confirmed based on the results from cytochemical staining. To our knowledge, this is the first case of DLBCL of the spleen in a horse investigated with the combined use of FC (CD21+ and cyCd79+) and immunohistochemistry (CD20+). Moreover, the FC showed the presence of a small population of CD21+ cells in the peripheral blood (0.1%) and in the bone marrow (0.2%). These data may suggest a dissemination of the neoplasm; nevertheless, there are no studies regarding cut off of infiltration by neoplastic cells of the blood and bone marrow in horses. In dogs a cutoff of 3% infiltration is used to discriminate dogs having different prognoses (30). Thus, the very low percentage of cells CD21+ in this case seems to be inconsistent with tumor dissemination. In fact, despite the high mitotic index of the lymphoma cells, no invasive growth or metastasis was observed in a previous case (25). In humans, PMLS has been described to metastasize to the splenic lymph node and rarely to other organs, although metastasis to the bone marrow, liver, and other lymph nodes has been reported. Human patients with only splenic involvement have a favorable prognosis after splenectomy (31). The prognosis in horses is not defined. In our case, the owner did not allow surgery, and the animal died after several days; in the other case reported in the literature the animal was euthanized for another cause, and the mass was found during necropsy (25).

Horses 3 and 4 had lymphoma of the third eyelid; adnexal lymphoma is an uncommon neoplasm, and there are limited reports of solitary forms in the literature. Lymphoid tissue of the ocular adnexa is sometimes an affected site in the course of the multicentric form (7,8,32,33). In both animals, the absence of involvement of tissue other than the third eyelid indicated a solitary/atypical form of the neoplasm. Unfortunately, in Horse 3 the lack of necropsy prevented us from excluding a multicentric form. In contrast, in Horse 4, the long follow-up (2 y) and the good health status suggest a solitary form of lymphoma.

Equine conjunctival, corneoscleral, and extraocular lymphoma appears to be present in 2 varieties: nodular and diffuse (8). In both horses the histological evaluation of both the third eyelids showed a diffuse infiltration of lymphocytes. The diffuse infiltration seems to be more malignant in nature than the nodular form and to be related to a poor outcome, as seen in Horse 3 (8). Notably, in that horse, histology showed a high mitotic index and infiltration extended beyond the margins of the tissue removed. In fact, surgical excision followed by evaluation of surgical margins is the treatment of choice for all periorbital neoplasia. Moreover, in cases of diffuse infiltration lacking clean margins, enucleation of the eyes should be performed to avoid dissemination of the neoplasm and more aggressive behavior of the tumor (8). In Horse 3, a subsequent enucleation was not possible, and the animal later died. In contrast, Horse 4 had a good outcome despite the diffuse architecture of the neoplastic tissue; this outcome may be associated with the radical removal of the tumor, which was made possible by the absence of neoplastic cells into the margins. As described in another horse with third eyelid lymphoma (34), a good surgical treatment allows for a long survival.

In both horses, the mandibular lymph nodes were enlarged because of granulomatous lymphadenitis in Horse 3 and chronic (macrophage) lymphadenitis in Horse 4. Granulomatous inflammation is observed in the course of infections of verminous, bacterial, fungal, or foreign body origin (35,36); nevertheless, in the course of lymphoma reports have indicated increased production of interferon-γ by the neoplastic T-lymphocytes, thus increasing the number of multinucleated cells surrounding the neoplastic lesion (14,37). The cytological results and the negative bacterial culture support this hypothesis.

The phenotype of third eyelid lymphoma is rarely reported; in this report, the use of IHC allowed us to make a diagnosis of T-cell lymphoma in Horse 3 and TCRLBCL in Horse 4. The T phenotype of the neoplasm in Horse 3 was linked to a poor prognosis; to our knowledge, Horse 4 is the first described case of equine TCRLBCL of the third eyelid (8,33).

The differential diagnosis for third eyelid lymphoma includes extraocular pseudotumors. Histologically, they are characterized by nodules or lymphoid follicles and by different types of cells (lymphocytes, macrophages, plasma cells), and generally there are no systemic signs (38). The diagnosis of lymphoma was based on the histological architecture which indicated a diffuse infiltration of lymphoid cells; furthermore, the use of IHC showed an infiltration of only T-cells in Horse 3, and T- and B-cells in Horse 4. Extracocular pseudotumors were therefore not considered, and lymphoma of the third eyelid was diagnosed.

Likewise, the increases in serum SAA and fibrinogen could also indicate that there was inflammation, maybe linked to the neoplasia. In fact, no laboratory test is 100% sensitive and 100% specific for any disease including neoplasia and the combined use of different diagnostic tools is necessary.

Interestingly, in all cases described herein neoplastic samples showed EHV-5 positivity in biomolecular investigation. Recently EHV-5 has been associated with some forms of equine lymphoma (multicentric, cutaneous, and solitary), with a TCRLBCL or T phenotype (3,39). Notably, in one of these cases (solitary TCRLBCL of mandibular lymph nodes) recurrence was observed 7 mo after surgery and chemotherapy. Therefore, the animal patient was treated with acyclovir, and complete remission was reported (39). However, the correlation between EHV-5 and lymphoma in horses has not been established, although gamma herpesviruses have been associated with malignant and non-malignant lymphoproliferative disorders in humans, mice, and poultry (40). Owing to this recent information, viral involvement in equine lymphoma should be analyzed more carefully to improve diagnosis and therapy.

In conclusion, cytological, histological, and immunophenotypic techniques can aid in achieving a complete antemortem diagnosis and defining a precise prognosis and treatment course for equine lymphoma. The description of these solitary cases and the results of thorough diagnostic investigations improve understanding of this neoplasia. Furthermore, future investigations into, LDH isoenzyme concentrations in equine lymphoma should be performed to evaluate their possible prognostic value.
Finally, studies on the possible involvement of EHV-5 in the initiation or development of lymphoproliferative neoplasia should be performed.

Acknowledgments

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References

Perceptions of community cats and preferences for their management in Guelph, Ontario. Part I: A quantitative analysis

Lauren Van Patter, Tyler Flockhart, Jason Coe, Olaf Berke, Rodrigo Goller, Alice Hovorka, Shane Bateman

Abstract — In 2014, 116 Guelph residents were surveyed to investigate attitudes about community cats and preferences for population management. There are an estimated 29,579 owned cats in Guelph, an estimated 40% of residents allow outdoor access to their cat(s), and 8,054 households (15%) feed community cats. Participants reported more concern with community cat welfare than nuisance behavior. There were high levels of support for responsible pet ownership education (90%), accessible or low-cost spay/neuter (86%), and trap-neuter-return (78%), and low levels of support for inaction (4%) and euthanasia (20%). Respondents who did not own cats or who considered cats as “pests” or a “non-native, invasive species” were more supportive of euthanasia. Results suggest that Guelph residents want to see action taken to address community cat population concerns, and that proactive management tools such as education, accessible or low-cost spay/neuter, and trap-neuter-return would be well supported and less divisive than euthanasia.

Introduction

The domestic cat (*Felis catus*) is the most popular pet in Canada, with approximately 36.9% of households owning 1 or more cats, and an estimated total of 9.3 million owned companion cats in the country (1). A 2017 Canadian Federation of Humane Societies report states that 2/3 of stakeholders (animal rescues, municipalities, and veterinarians) believe their community is currently experiencing a cat overpopulation crisis, although there has been a downward trend among most stakeholder groups over the past 5 y (1). In addition to the homeless...
cats living in shelters, there is a population of free-living stray or feral community cats. For the purposes of this study, “community cats” were defined as:

*Cats that spend all of their time outdoors and do not currently have an owner who is actively caring for them. Some of these cats have never been socialized and are extremely frightened of human interaction (often termed feral). Some of these cats have had a home or have become accustomed to human interaction and have the potential to be adopted or to live successfully in a home with a new owner (sometimes termed stray). In some cases these cats exist as part of a colony in which humans provide food/water, shelter, and some basic preventive healthcare (spay/neuter, vaccinations).*

Media attention surrounding the overpopulation of cats in Canada has led to vigorous debate about how communities can best formulate solutions. High-quality scientific evaluation of community cat populations relevant to the geographic and climatic features of Canada is scarce. Thus, without community-specific information such as cat population sizes and citizen opinions, strongly opposing viewpoints persist and action on the issue remains a challenge.

Some citizen advocates are concerned about community cat welfare, and there is considerable debate about the quality of life and longevity of community cats, with some sources estimating an average lifespan of only 2 y (2,3). Trap-neuter-return (TNR) is frequently advocated as a humane alternative to trap and removal, which generally results in euthanasia (4). One of the greatest challenges in implementing community cat management strategies is managing public opposition, as there can be strong diverse opinions on the acceptability of competing approaches such as TNR and euthanasia (5–7). Humane alternatives require community-specific engagement and consensus to draft policy and implement actions.

Most research investigating public preferences for the management of community cats has occurred in the United States. Such studies have reported a wide range in levels of support for TNR (7), from 38% in Texas (in suburban neighborhoods) (8) to 76.6% in Ohio (9). Greater support for non-lethal control measures such as TNR has been found among: cat owners (9,10), women (6,8), and urban dwellers (6). Reasons for not supporting TNR have been identified as: previous negative experiences with cats (6), viewing cats as a nuisance (8), and doubting its effectiveness (8).

Little research has been conducted on community cats in the Canadian context. On a national scale, a study by Environment Canada (11) employed extrapolation and data from other countries to estimate the national feral cat population at 1.4 to 4.2 million, and concluded that feral cats were responsible for the majority of the estimated 100 to 350 million birds killed annually by cats in Canada. National surveys have investigated the demographics of companion animals in Canada, and highlighted the unique challenges facing owned and sheltered cats (1,12). These studies speculate that there is a decreased value placed on companion cats compared with dogs and advocate improved understanding and initiatives to change the culture of cat ownership. On a regional scale, a study from southern Ontario used semi-structured interviews to investigate perceptions of feral cats and debate surrounding urban colonies, concluding that tolerance is spatially dependent, with feral cats viewed as belonging more on farms and less in wilderness areas (13). Locally, the total population size of free-roaming (community and owned-outdoor) cats in Guelph was estimated at 7662 (95% bootstrap CI: 6145 to 9966) using transect sampling (14). No previous studies have surveyed public perceptions of community cats or preferences for their management in the context of a specific community in Canada. Possible regional differences in values and preferences highlight the importance of conducting such research in novel contexts (6,15,16).

To fill this knowledge gap on community cat abundance and citizen opinions, various stakeholders formed the Guelph Cat Population Taskforce (GCPT) in 2013. As a collaborative, community-based initiative, the GCPT aims to: support research on community cats; promote outreach, education, and community involvement; and eliminate the euthanasia of healthy cats. Using data collected by the GCPT from surveyed Guelph residents, the objectives of this research were to: i) determine attitudes and opinions about owned and community cats; ii) determine acceptable actions to address cat population management; and iii) inform the development of community outreach and education efforts.

**Materials and methods**

**Survey design and data collection**

This research was undertaken from 2014 to 2015 in the city of Guelph, a medium-sized city in southwestern Ontario located 100 km west of Toronto. It is home to the Ontario Veterinary College at the University of Guelph. A pre-test of the survey was conducted with 10 individuals in August 2014 using the City of Guelph online poll administration software service (17). Results and feedback from this pre-test were used to modify the questionnaire and arrive at the final survey design. The survey (available on request from the corresponding author) comprised 4 sections and focused on: perceptions of community cats; views and values concerning community cats; preferences for community cat management; and personal and demographic information, some of which was optional. The survey was composed of a combination of multi-select, open-ended, and Likert Scale questions.

The survey was administered in person in November 2014 using convenience sampling. Participants were recruited to complete paper surveys at 6 primary public locations throughout the city. Using this method 2 GCPT members and 5 Guelph Humane Society volunteers recruited 116 participants. Additionally, 333 participants in the city completed an identical web-based survey between December 2014 and March 2015 (18). Due to significant differences in demographics and suspected selection bias in the web-based survey, the datasets were not combined, and only the in-person survey results are reported herein. For a qualitative analysis of responses to open-ended questions in both the in-person and web-based survey see Part II of this manuscript series (18). Ethics approval for this research was obtained from the University of Guelph Research Ethics Board (REB# 14JN012).
determine if the observed number of respondents was signifi-
cantly different from expected. The open software program R
(21) was used for all statistical analyses. The significance level
\( \alpha = 0.05 \) was applied in all tests.

**Results**

In 2016, Guelph had a population of 131,794 people and
55,927 households. Of the 116 respondents, most were female
(55%) and had post-secondary education (76%). Approximately
1/3 of all respondents said they owned 1 or more cats, which
resulted in an estimate of \( \sim 30,000 \) owned cats in Guelph
(Table 1). The majority (60%) of cats were indoor only
(\( \sim 17,885 \) indoor-only cats in Guelph), while 40% of house-
holds allowed outdoor access to their cats (\( \sim 11,694 \) indoor-
outdoor cats in Guelph; Table 1).

Most respondents (62%) were aware of 1 or more community
cats around their home. Approximately 15% (95% CI: 9% to
23%) of respondents currently feed or have fed community cats
around their homes, resulting in a city-level estimate of 8054
households engaging in community cat feeding (Table 1). Of
the respondents who fed cats, 43% had not fed any cats in the
past year, 38% had fed 1 cat in the past year, and 19% had fed
2 or more cats in the past year. Forty-one percent of respondents
agreed that community cats were a problem in Guelph, with 16% strongly or somewhat agreed that community cats were a problem in Guelph, and 29% strongly or somewhat agreed that community cats were a problem in their neighborhood (Table 2).

Most respondents (78%) viewed community cats as “aban-
donated, homeless pets.” Thirty-two percent of respondents con-
sidered community cats to be “beneficial for rodent control.”
Twenty-five percent of respondents considered community
cats to be a “non-native, invasive species,” while 16% consider-
ing community cats to be “a natural part of the ecosystem.”
Seventeen percent of respondents viewed community cats as
“pests” (Figure 1).

Concerns about community cats were highest for issues
surrounding cat welfare, followed by wildlife damage, public
health, and nuisance (Figure 2). In terms of cat welfare, the
greatest number of participants were concerned about community
cats starving (73%), followed by vehicular injury (59%),
and infectious disease (57%), and finally predation by coyotes,
etc. (46%) (Figure 2). Respondents were more concerned with
community cats killing birds (53%) than they were with cats
killing other animals (35%) or spreading diseases to wildlife
(31%) (Figure 2). More than twice the number of participants
were concerned with community cats transmitting diseases or
parasites to the public (41%) than with cat bites or scratches
(18%) (Figure 2). Smaller percentages of respondents were

### Table 1. Estimates and 95% confidence intervals of proportions
and totals of certain cat populations and related households in
Guelph, Ontario, 2014.

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion households owning cat</td>
<td>0.37 (0.28 to 0.47)</td>
</tr>
<tr>
<td>Mean number of cats per owning household</td>
<td>1.48 (1.25 to 1.74)</td>
</tr>
<tr>
<td>Proportion of cat-owning households</td>
<td>0.40 (0.25 to 0.56)</td>
</tr>
<tr>
<td>allowing outdoor access</td>
<td></td>
</tr>
<tr>
<td>Total owned cats</td>
<td>29,579 (22,089 to 39,610)</td>
</tr>
<tr>
<td>Total indoor-outdoor cats</td>
<td>11,694 (5517 to 22,019)</td>
</tr>
<tr>
<td>Total indoor-only cats</td>
<td>17,885 (9810 to 29,717)</td>
</tr>
<tr>
<td>Proportion of households that feed or</td>
<td>0.15 (0.09 to 0.23)</td>
</tr>
<tr>
<td>have fed community cats around their</td>
<td></td>
</tr>
<tr>
<td>homes</td>
<td></td>
</tr>
<tr>
<td>Number of households feeding community</td>
<td>8054 (4734 to 12,477)</td>
</tr>
<tr>
<td>cats</td>
<td></td>
</tr>
<tr>
<td>Number of respondents</td>
<td>116</td>
</tr>
</tbody>
</table>

### Table 2. Responses to the question “Are community cats a
problem in Guelph or your neighborhood?” Not all respondents
answered the questions, so the sample size is less than the total
number of respondents.

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Guelph</th>
<th>Neighborhood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>8%</td>
<td>8%</td>
</tr>
<tr>
<td>Somewhat agree</td>
<td>33%</td>
<td>21%</td>
</tr>
<tr>
<td>Neutral</td>
<td>33%</td>
<td>24%</td>
</tr>
<tr>
<td>Somewhat disagree</td>
<td>14%</td>
<td>23%</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>12%</td>
<td>24%</td>
</tr>
<tr>
<td>Number of respondents</td>
<td>112</td>
<td>113</td>
</tr>
</tbody>
</table>

**Data analysis**

Demographic data and the number of dwellings (including
houses, apartments, and townhomes; hereafter referred to as
households) in the city of Guelph were obtained from the
Canada Census Program (19). Survey respondent data on cat-
ownership (the sample proportion) were used to estimate the
proportion of households owning a cat in Guelph (the target
population). The 95% confidence interval (CI) was estimated
using the exact or Pearson-Clopper method. A Poisson model
was then fitted using the quasi-likelihood estimation method
due to over-dispersion (owing to the mean being larger than
the variance of the raw data using only households with 1 cat
or more) using the survey data to estimate the mean and 95%
CI of the number of cats in cat-owning households. To estimate
the number of owned cats in Guelph the number of households
was multiplied by the proportion of households owning cats
and the number of cats in each cat-owning household (20). To
estimate the number of indoor-outdoor owned cats in Guelph,
the number of owned cats was multiplied by the estimated mean
of a binomial distribution and exact 95% CI of the proportion
of households that provide outdoor access to their cats (14).

The number of indoor-only cats was 1 minus the estimated
proportion of households that provided outdoor access to their
cats multiplied by the number of owned cats.

Relationships between the perceived effectiveness of and
support for euthanasia as a management tool and 2 other vari-
ables were tested to see if respondents owned 1 or more cats,
and whether they considered community cats to be “pests” or
“non-native, invasive species.” People who classified euthanasia
to be “effective” were considered as those who responded that
euthanasia was extremely effective or somewhat effective. People
who classified euthanasia as “ineffective” were considered as
those who indicated that euthanasia was extremely ineffective
or somewhat ineffective. People who strongly supported or
somewhat supported euthanasia were considered as “supportive”
and those who strongly did not support or somewhat did not
support euthanasia were classified as “not supportive.” Using
these classifications, 2-tailed Fisher exact tests were used to
determine if the observed number of respondents was signifi-

![Figure 1](image1.png)

![Figure 2](image2.png)
concerned with nuisance issues such as cat feces (32%), getting into garbage (28%), spraying (24%), and noise (16%).

Participants believed that accessible or low-cost spay/neuter was the most effective management option, followed by responsible pet ownership education (e.g., information about spay/neuter, identification, vaccination, or nutrition), education (e.g., information about cat behavior and the issues around overpopulation), and TNR (Figure 3). Participants believed that doing nothing would be least effective, followed by euthanasia (Figure 3). Most respondents supported a range of potential management options. There was general agreement between participants’ beliefs about the effectiveness of management options and their level of support for these strategies. Respondents most strongly supported responsible pet ownership education, education, accessible or low-cost spay/neuter, and TNR (Figure 4). Participants were least supportive of inaction and euthanasia (Figure 4).

There was no significant difference between respondents who considered community cats as “pests” or a “non-native, invasive species” (n = 41) and those who did not (n = 75), in terms of their perceived effectiveness of euthanasia to reduce cat populations [odds ratio (OR) = 2.28, P = 0.13]. Despite this, respondents who considered community cats as “pests” or a “non-native, invasive species” were in significantly greater support of implementing euthanasia to reduce cat populations in Guelph than those who did not (OR = 5.07, P = 0.002; Figure 5, right panel). There was no significant difference between respondents who owned a cat (n = 43) and those who did not own a cat (n = 73), in terms of their perceived effectiveness of euthanasia to reduce cat populations (OR = 0.42, P = 0.14). Despite this, cat owners were significantly less supportive of implementing euthanasia to reduce cat populations in Guelph than those who did not own cats (OR = 0.20, P = 0.01; Figure 5, left panel).

Most respondents (49%) believed the role of the GCPT should be to decrease the population of community cats, 31% believed it should be to stabilize the population, 10% believed it should be to eliminate the population, and only 3% believed it should be to do nothing (7% did not respond).

**Discussion**

This paper provides community cat population estimates and perceptions and preferences for community cat management in Guelph, Ontario. We estimate that there are just under 30 000 owned cats in Guelph, or approximately 1 cat for every 4 citizens. Our estimate of the number of indoor-outdoor cats (11 494; 95% CI: 5517 to 22 019) overlaps with an independent estimate of free-roaming cats (7662; 95% CI: 6145 to 9966) (14) using walking transect sampling. Deriving similar results in the same study area using different techniques reinforces our confidence in population estimates and provides stronger evidence to help guide conversations about community cats and their management. Communities wishing to develop strategies to address cat population concerns should similarly consider developing multiple models of cat population abundance and distribution given that population abundance is a metric frequently used to define the success or failure of cat management strategies (1).

Most respondents (62%) were aware of community cats around their home. A low percentage (29%) answered that community cats were a problem in their neighborhood, but more (41%) believed community cats were a problem in Guelph as a whole. Similar findings were reported in Ohio, where 30% of participants agreed that free-roaming cats were a problem in their neighborhood, whereas 45% agreed they were a problem in the State (9). The sources of perceptions that there are community cat problems elsewhere are unclear, but could include firsthand knowledge, stories or impressions gleaned from others, or possibly assumptions from learning that a survey on community cats is being conducted in that locale. Approximately 8000 households (15%) in the city of Guelph feed or have fed community cats, less than that reported in Ohio (26%) where rural residents were more likely to feed free-roaming cats than were urban or suburban residents (9). Our estimate of the number of households feeding free-roaming (owned or unowned) cats in Guelph. Observed discrepancies between our results and other studies could be a result of differences in survey design, surveys with small sample sizes, or regional/cultural differences. It highlights the importance of accurate, place-specific data on attitudes and behaviors towards community cats that may influence the success of outreach efforts (22).
In agreement with previous research from southern Ontario, respondents most frequently perceived community cats as “abandoned, homeless pets” and therefore were most concerned with cat welfare (13). Few respondents considered community cats to be “pests,” and accordingly there was relatively little concern with nuisance issues such as feces, spraying, and getting into garbage among respondents in the current study. Our findings on perceptions of community cats differed markedly from those reported in Georgia, where 50% of participants classified feral cats as a “nuisance” and only 38% believed that feral cat welfare was important (15). This discrepancy could be due to the higher population densities of community cats expected in more temperate climatic conditions (23), and the identified negative correlation between tolerance for outdoor cats and perceived abundance (24). Alternatively, this finding may be a result of differences in culture and prevailing attitudes about animal welfare among geographic regions (16). Given the lack of data, it is difficult to know if these attitudes are widespread across Canadian cities or how attitudes may have shifted over time as community cat management has garnered increasing media attention across North America.

In terms of community cat management, Guelph residents want action taken to reduce or stabilize the population of community cats. Only 3% responded that the GCPT was not needed and 4% supported no action being taken. Only 10% of respondents to the current survey answered that the community cat population should be eliminated, possibly because some level of community cat population was viewed as acceptable, or for fear that “eliminate” implied lethal removal. Only 20% of respondents in this survey supported euthanasia, which is much less than reported in Georgia (44%) (15). The greatest support in our study was for proactive approaches such as responsible pet ownership education (90%) and accessible or low-cost spay/neuter (86%). There was also strong support for TNR (78%), similar to findings from Ohio (76.6%) (9), and California (76%) (10). Conversely there was much less support for TNR than was found in Georgia (49%) (15), Texas (8), and Hawaii (25). These discrepancies suggest that there are potential regional and temporal differences in prevailing attitudes towards cat management practices and their effectiveness. Communities implementing new strategies may benefit from an assessment of local perceptions and attitudes. Our findings suggest that in our community there is broad support for multi-faceted, proactive approaches that maximize cat welfare and improve cat ownership practices.

In terms of perceived effectiveness of the various management tools, our study found that many more respondents
One limitation of this study is the small sample size. The overall study also comprised 333 web-based responses; however, these data were not combined because of significant differences, which we believe to be indicative of greater self-selection bias in the web-based survey. Self-selection bias occurs when only individuals who feel strongly about the issue in question are likely to complete the survey. There is some evidence to suggest that self-selection bias and nonresponse rates may be greater in web-based versus paper surveys (29,30). Therefore, the small sample resulting from the labor- and time-intensive in-person method was a trade-off for a more representative sample. A limitation of quantitative analyses of surveys in studying human-animal relationships is that they can oversimplify complex perceptions and values (31). Consequently, to complement and extend the findings in this manuscript we have reported separately on the qualitative analysis of the in-person and web-based surveys’ open-ended questions to explore the underlying views and values that contribute to the findings reported herein (18).

Our study provides a list of supported actions that could be applied in a management plan for community cats in Guelph. Management actions, combined with their associated level of support, can be applied to population models (32) to understand how different strategies are likely to influence the cat population composition and structure. When integrated with estimated costs of each management action, these population modeling exercises can illuminate the optimal approach to meet management objectives, such as reducing the number of community cats by a given percentage, while accommodating community-specific preferences for certain management tools (e.g., TNR, education) over others (e.g., euthanasia). Overall, the results of the current study suggest that Guelph residents want to see action taken to address community cat population concerns. Proactive management tools such as education, accessible or low-cost spay/neuter, and TNR would be well-supported by the community. The GCPT will use these results to advocate for continued research and action concerning community cat management in Guelph.

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17. Polldaddy Ltd., Sligo, Ireland.


Perceptions of community cats and preferences for their management in Guelph, Ontario. Part II: A qualitative analysis

Lauren Van Patter, Tyler Flockhart, Jason Coe, Olaf Berke, Rodrigo Goller, Alice Hovorka, Shane Bateman

Abstract — Implementation of cat population management strategies that are effective and supported by the community requires knowledge of local contexts, public values, and preferences. From 2014 to 2015 the Guelph Cat Population Taskforce surveyed Guelph, Ontario residents to investigate attitudes and values concerning community cats and preferences for cat population management. Responses from 449 individuals were received through a combination of paper and online surveys. The results of a qualitative analysis of 7 open-ended survey questions are reported herein. Results indicate that community cat issues are largely attributed to perceptions of irresponsible pet ownership practices, highlighting the opportunity for public education. Participants identified the whole community as responsible for addressing the problem, suggesting the value of collaborative management approaches. This analysis also illuminated opportunities for combining well-supported strategies such as accessible or low-cost spay/neuter and trap-neuter-return (TNR) to implement a multifaceted approach. Overall, Guelph residents who responded to the survey gave a high priority to proactive, humane management of community cats.

Résumé — Perceptions à l’égard des chats communautaires et préférences pour leur gestion à Guelph, en Ontario. Partie II : analyse qualitative. La mise en œuvre de stratégies de gestion de la population de chats qui sont efficaces et appuyées par la collectivité exige la connaissance des contextes locaux ainsi que des valeurs et des préférences du public. De 2014 à 2015, le Groupe de travail sur la population de chats de Guelph a effectué une enquête auprès des résidents de Guelph, en Ontario, afin de connaître leurs attitudes et leurs valeurs à propos des chats communautaires et de leurs préférences pour la gestion de la population de chats. Des réponses ont été reçues de la part de 449 personnes sous forme d’une combinaison de sondages en format papier et en ligne. Les résultats de l’analyse qualitative de sept questions à développement sont présentés dans le présent article. Les résultats indiquent que les problèmes liés aux chats communautaires sont attribués en grande partie à des perceptions de pratiques de possession irresponsible d’animaux de compagnie, ce qui souligne une occasion d’éducation publique. Les participants ont identifié l’ensemble de la collectivité comme étant responsable de la résolution du problème, ce qui suggère la valeur d’approches de gestion concertée. Cette analyse a aussi mis en lumière des occasions de combiner des stratégies bien soutenues, comme la stérilisation accessible ou à faible coût et la capture-stérilisation-mise en liberté, afin de mettre en œuvre une approche à facettes multiples. Dans l’ensemble, les résidents de Guelph qui ont répondu à l’enquête ont accordé une priorité élevée à la gestion proactive et non cruelle des chats communautaires.

(Traduit par Isabelle Vallières)

Introduction

The management of free-living, stray, and feral — henceforth referred to as “community” cats (Felis catus) has implications for the veterinary and animal welfare community. Two-thirds of stakeholders in a recent national survey felt that there was a cat overpopulation crisis in their community (1). Diverse cat population management approaches such as trap-neuter-return (TNR) and euthanasia can be met with both strong support and opposition in any given community. In order to implement cat population management tools that are both
effective and supported by the community, greater knowledge of local contexts and public values is necessary (2). The current dearth of information from Canadian contexts prevents municipalities from creating effective and sustainable urban animal strategies (3).

Little research has been conducted on community cats in the Canadian context (notable exceptions: 3–8). In the United States, surveys have been used to investigate public interactions with, perceptions of, and preferences concerning free-roaming cats in Texas (9), California (10), Ohio (11), Illinois (2), Georgia (12), and Hawaii (13). These studies use quantitative approaches to generalize results to the broader population. Quantitative analyses of human-animal relationships can oversimplify complex perceptions and values (14). While there are strengths to quantitative methods, qualitative approaches are particularly advantageous for understanding complex phenomena, personal experiences, and local contexts (15). By combining qualitative and quantitative methods using a mixed-method approach, research can attain both depth and breadth, generating a more holistic understanding of the research topic (15,16).

This research was undertaken from 2014 to 2015 in the city of Guelph by the Guelph Cat Population Taskforce (GCPT). Guelph is a medium-sized city in southwestern Ontario with a population of 131 794 (17). The climate is a challenge to the survival of community cats, with average winter (December–March, 1981 to 2010) temperatures of −4.1°C, and daily lows of up to −31.9°C (18). There is a strong veterinary infrastructure, with the Ontario Veterinary College, a well-organized local veterinary community, the Guelph Humane Society, and several smaller animal rescue/welfare organizations in the area.

The primary objective of our study was to gather data on perceptions and preferences concerning community cats, using the city of Guelph, Canada in order to inform cat management strategies and guide outreach and public education efforts. Additionally, our study sought to address gaps in the literature on public values and management priorities for community cats in Canada. A quantitative analysis of study findings are presented in our companion article in this issue, and report: an estimated 29 579 owned cats in Guelph and 8054 households feeding community cats; 41% of respondents believe community cats are a problem in the city; and high levels of support for responsible pet ownership (90%), accessible or low-cost spay/neuter (86%), and trap-neuter-return (TNR) (78%), and low levels of support for inaction (4%) and euthanasia (20%) (8). This report adds nuance to our quantitative findings by providing a qualitative analysis of participants’ written responses to 7 open-ended questions. The findings of this report both complement and extend the quantitative results, illuminating potential challenges and opportunities associated with diverse community cat management strategies.

### Materials and methods

A pilot survey of 10 respondents was initiated in August, 2014. The final survey had 4 parts: Part A investigated opinions on community cats, such as if they are a problem in the city/neighborhood, and the number of cats around participants’ homes. Part B explored perceptions of community cats, and

<table>
<thead>
<tr>
<th>Questions/Themes</th>
<th>Coding nodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are community cats a problem?</td>
<td>Yes a problem, Not a problem</td>
</tr>
<tr>
<td>Who is responsible for causing the community cat problem?</td>
<td>City, GHS, Owners, Other</td>
</tr>
<tr>
<td>Who is responsible for solving the community cat problem?</td>
<td>City, Community, everyone, GHS, SPCA, etc., Owners, Other</td>
</tr>
<tr>
<td>Community cat management preferences:</td>
<td>Education, Euthanasia, Implementation, resources, Licensing, bylaws, OVC, veterinarians, Owner regulation, Owned cat spay, neuter, TNR, Trap neuter-return</td>
</tr>
<tr>
<td>Other themes:</td>
<td>Bird, wildlife concerns, Nuisance, Welfare</td>
</tr>
</tbody>
</table>

* Guelph Humane Society.
* Ontario Veterinary College.
* Trap-neuter-return.

Emergent coding nodes in italics.

This research was undertaken from 2014 to 2015 in the city of Guelph by the Guelph Cat Population Taskforce (GCPT). The survey was implemented in the city of Guelph using 2 strategies: in-person and online. The in-person survey was administered in November 2014. Seven volunteers recruited survey participants at 6 locations throughout the city. The in-person survey was completed by 116 respondents. The online survey was open between December 2014 and May 2015 through The City of Guelph online poll administration software service (19). Participants were recruited through press releases in the news publications At Guelph (20) and the Guelph Mercury (21). A GCPT pamphlet containing the survey link was distributed throughout the city to pet stores, veterinary offices, and cafés. Survey links were available through the GCPT website and were circulated using social media. The online survey was completed by 333 respondents, for a total of 449 participants.

A qualitative analysis of questions 4, 8, 10, 11, 12, 14, and 22 (Appendix I) was undertaken using NVivo 11 (22). A thematic analysis (23) was performed to evaluate participants’ perceptions, values, and preferences concerning community cats. A combination of manifest and latent coding was employed, with some nodes (themes) established a priori and others emergent or developed as the data were analyzed (24) (Table 1).
Results

Participant demographics
Most participants were female (66.4%; male: 26.7%; prefer not to indicate: 2.4%; other: 0.9%; no response: 3.6%; N = 449). Participants’ ages encompassed a broad range (under 20: 1.8%; 20 to 30: 24.1%; 31 to 40: 16.9%; 41 to 50: 18.7%; 51 to 60: 19.2%; 61 to 70: 11.8%; over 70: 4.9%; no response: 2.7%; N = 449). The highest level of education attained by most participants was post-secondary education (84.0% — elementary: 0.2% — high school: 12.2% — no response: 3.6%; N = 449).

Perceptions of community cats in Guelph
Are community cats a problem in my neighborhood?
Most participants did not perceive community cats as a problem in the city or their neighborhoods for 2 reasons. Firstly, participants explained that they weren’t aware of community cats in the area: “I’ve never even seen a stray cat in any of my home neighborhoods... so I had no idea that feral cats were any sort of problem in Guelph.” “I’ve been living in Guelph nearly 10 years, spend a lot of time outdoors, and cannot once recall having an issue with community cats.” Secondly, some people indicated that there were community cats in the area but they did not view this as problematic: “I don’t mind them. There aren’t large numbers in my area and those that are seem well-fed; “A few that hang around, they don’t really bother us.” Participants who did believe community cats were a problem explained: “The amount of roaming cats throughout this city is unacceptable;” and “Both community cats and owned outdoor cats are a big problem in my neighborhood.”

Who is responsible for causing/solving community cat problems?
The majority of participants who considered community cats to be a problem felt that irresponsible cat owners were the primary cause. Lack of responsible pet ownership was generally characterized as: not spaying/neutering cats, letting cats roam outdoors, or abandoning them. For example, respondents wrote that community cat problems were caused by: “People who do not spay/neuter their cats and/or abandon them;” and “People who acquire cats without thinking it through beforehand.” One participant further explained: “there will always exist a segment of pet owners within the population who is ignorant, immature, apathetic, or a poor decision maker,” who will “continue to let their cats roam the neighborhood unfixed.” A number of participants identified the community as a whole as responsible, for instance writing: “We all are. Ignoring a problem is as bad as creating it.”

In terms of who is responsible for solving community cat problems, 4 main answer or opinion categories emerged: cat owners, the City of Guelph, animal organizations, and the community as a whole. In terms of cat owner responsibility, respondents explained: “Owners should be spaying/neutering their cats, and not letting them outside;” and “Owners but not all owners are responsible or concerned or think this is an issue. So then it falls onto the municipality to incorporate cats into the Nuisance Animal By-Law and enforcement.” As demonstrated by the latter statement, many participants who identified irresponsible cat owners as the cause of the problem identified the City of Guelph as responsible for solving it: “Pet owners won’t therefore city?” “I think the city needs to provide the resources to solve the problem, including engaging caregivers, rescue groups, shelters, vets, local businesses, the University of Guelph and the Veterinary College.” In terms of animal organizations, participants included “Animal control/animal shelters” and the “pet care community,” although the majority specifically identified the Guelph Humane Society. Finally, a great number of participants identified the entire community as responsible for solving the problem: “We all should be i.e., the community;” “Community of Guelph; needs to be a group effort.”

Wildlife concerns
A collection of survey respondents had concerns about the impacts of community cats on wildlife populations, especially songbirds: “These community cats are very good hunters and are disrupting the natural ecosystem by killing small game that could be food for natural predators such as foxes and owls; “they are NOT a part of the local ecosystem and wildlife should not be subjected to their predatory behavior.”

Nuisance concerns
Some participants expressed concerns with the nuisance posed by community cats: “They pee/spray on our house, they fight at night, they get into garbage, they sleep on my porch furniture;” “They damage my property by spraying defecating in my gardens and on my house. They are loud when fighting and mating.” Despite these concerns, other participants felt that owned outdoor cats were responsible for such nuisance behavior rather than community cats: “I have more of an issue with cats owned but let out to roam free.” Additionally, several participants specifically wrote that cats were not a nuisance: “They don’t seem to be a nuisance in my neighborhood;” “They are hungry and living on our property. They are respectful and no trouble.”

Welfare concerns
Most participants expressed concern about the welfare of community cats: “Cats are not equipped to handle the risks associated with a life outdoors and nor should they have to. As a community we should be responsible for these animals and want to improve their welfare;” “I worry about these cats suffering particularly in the winter months.” Participants who fed community cats often explained that their behavior was fueled by compassion and the desire to alleviate suffering: “I feel sorry for them. I can’t see an animal outside cold and hungry and not do anything;” “They are hungry. They also deserve the best chance in life they can get.” Finally, participants emphasized humane population control measures: “Whatever methods are used for decreasing the population of Community Cats, consideration must be given to the humane treatment of all animals;” “All they know is that they would like to survive so I think the solution should be to put the cat welfare first priority.”

Cats as victims
A discursive construction that emerged from the survey was that of cats as blameless victims: “we should remember that it
The following education strategies were suggested by 2 participants: "Education in the community is most important." Public about responsible pet ownership and the plight of community cats: "Please educate the public about responsible pet ownership and the plight of community cats;" "Education in the community is most important." The following education strategies were suggested by 2 participants: "Free seminars at the library? Pamphlets in grocery bags? Talking to young children about animal care?" and "Directed extension: people (e.g., students during the summer) trained to visit homes and talk with those people who have pets about the issues surrounding loose cats in the city… just blanket education through flyers or news articles will do almost nothing."

Despite the large number of participants who wrote about the need for education, a number identified that relying on education alone would not be effective: "Educating people about responsible pet ownership is a huge waste of resources. Pet owners who are responsible already know and those who aren’t don’t care;" "I do not believe “education” is the key here as this information has been available for a long time and owners just don’t believe it."

Preferences for community cat management in Guelph

Pet-owner education

Participants often advocated for greater education in terms of the importance of spaying/neutering and the risks associated with allowing cats to roam freely outdoors: "Please educate the public about responsible pet ownership and the plight of community cats;" "Education in the community is most important." The following education strategies were suggested by 2 participants: "Free seminars at the library? Pamphlets in grocery bags? Talking to young children about animal care?" and "Directed extension: people (e.g., students during the summer) trained to visit homes and talk with those people who have pets about the issues surrounding loose cats in the city… just blanket education through flyers or news articles will do almost nothing."

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Bylaws

Many participants wanted to see bylaws enforced that would prevent owned cats from contributing to community cat populations. Some individuals suggested bylaws against free-roaming, for instance advocating for: "City bylaws to stop cats from running at large;" and "fines on owners of cats that are repeatedly found to be roaming free." Several people felt that cats should be "licensed and leashed, just like dogs." Others suggested "a community bylaw for spaying or neutering owned outdoor free running cats." Some participants wrote that a licensing scheme would have the added benefit of providing funds for other aspects of community cat management: "Require cats to be registered, like dogs, with a fee. The fee could go to help offset costs of problems related to feral cats;" "fine income can be used to fund other necessary animal services." Other respondents were concerned that implementing licensing schemes could result in increased abandonment. As 2 participants explained: "My concern with some initiatives (identification, for example) is that the responsible pet owners will do it and end up paying more, and the irresponsible owners will simply abandon more pets;" "I would be concerned that simply creating a restrictive bylaw could cause a hostile backlash and result in more cats being brought to shelters where they would have to be euthanized."

Finally, several participants mentioned restricting animal sales in pet stores: "Enforcing policies at a federal level that deter sales of pets in pet stores;" "Reducing/Regulating non-home-based kitten sources, e.g., Pet stores not buying from “kitten mills,” not selling cats at all, barn cats being monitored."

Accessible or low-cost spay/neuter

A number of participants noted the importance of accessible or low-cost spay/neuter options, especially for lower income households: "We need a CHEAP spay/neuter clinic or mobile clinic in town such as what other cities have. Most people cannot afford vet fees which are going up at an increasing rate per year;" "There is no low cost spay/neuter facility near Guelph, which would assist low income people in reducing the number of reproducing cats." Several respondents noted the availability of low-cost spay/neuter options in other communities in Ontario: "Newmarket and Barrie have $60 neuter plan subsidized by taxes." In terms of the logistics for implementing such a strategy, 1 participant suggested: "Three-way funding for spay/neuter divided between the municipality, pet owners, and veterinarians."

Trap-neuter-return (TNR)

Some participants felt that TNR would not be an effective solution or were concerned with the resources required: "Spay or neutering is not only a financial burden it doesn’t cure the problem for years to come;" "neuter/spay and return seems less cruel [than euthanasia], but I doubt its overall effectiveness." Others were concerned about the impacts of colony cats on wildlife, especially songbirds: "I like the concept of TNR but am also concerned about the impact those colonies have on bird populations."

In terms of support for TNR, it was advanced as an effective means of reducing the community cat population: "Trap-neuter-return is important … this will hopefully decrease their numbers;" "by stabilizing their current population (trap, neuter, and return is awesome) within a few years numbers would go down naturally." Many participants were also supportive of TNR because they saw it as a humane alternative to euthanasia. As 2 participants explained: "I think focus should be doing TNR to reduce stray/feral populations so the humane society can cope and eliminate the need to euthanize;" "start a county group to help pay for TNR and stop shelters from killing." Others did not see TNR and euthanasia as mutually exclusive, suggesting both: "Euthanization and education and neutering/spaying seems to be the best;" "I think a combined Integrated Pest Management system should be put into place using Trap-Neuter/Spay-Release, habitat modification to deter feral cats, euthanasia to reduce over population." Other multi-faceted approaches were suggested: "I would like to see TNR programs in Guelph and low cost spay/neuter clinics;" "I see combination of education, accessible spay/neuter, and TNR as all important and necessary."

Euthanasia

A small number of participants argued that euthanasia would be the best measure, for several reasons: "Though harsh and unpleasant to think about, I believe euthanasia would certainly
be an effective solution;” “There is only one way to keep the population down and that is to capture and humanely euthanize them.” Others argued that euthanasia was not a welfare issue: “Feral cats should be euthanized. There is nothing inhumane in this, if it is done in the standard, accepted way by a veterinarian;” “if deer can be culled because they get too numerous and they are beautiful creatures why can't cats be captured and humanely put down.” Most participants indicated they were not supportive of lethal management of feral cats, for instance writing: “Please do not euthanize feral cat populations unless they are very sick!” and “I don't want to see community cats being euthanized in order to reduce their numbers.” Some participants doubted the efficacy of euthanasia, for instance: “Euthanasia...is the same as doing nothing, because it will result in the status quo being perpetuated which means no change in the inherent attitudes that result in high levels of stray cats;” “Removing cats has never proven to help. Other cats move in when you take a colony out of its area.” Others believed that euthanasia would be effective but did not support it: “I want to clarify the above part about euthanasia. Obviously, it would be extremely effective at curbing community cat problems; however, I do not want to see that as an option, that would be my last option.” Other participants echoed that euthanasia should only be used as a last resort: “I do not agree with euthanasia unless there is no other hope;”

“My strategy would be to spay/neuter/release as many feral cats as possible and trap and adopt as many as possible, while changing the cat bylaws and educating the public... If these ideas were not successful (i.e., could not spay/neuter enough of them, people kept releasing them, etc.) I think it would make sense to consider more drastic measures (i.e., euthanasia).”

### Discussion

This report complements and extends the quantitative findings of our survey (8) by presenting a qualitative analysis of participants’ responses to 7 open-ended questions. Key findings provide a more nuanced, in-depth understanding of how participants perceive community cats, as well as key opportunities for implementing community cat management strategies in the city of Guelph.

In terms of perceptions of community cats, written responses suggest that many participants did not see community cats as a problem in their neighborhood either because they were unaware of community cats around their homes, or they were aware of a small number of cats and did not view them as problematic. This suggests that some individuals may be tolerant to the presence of community cats. This further explains why only 10% of respondents wanted to see the community cat population eliminated (8). Written responses reinforced that, although there are some concerns about the impact of community cats on wildlife and the cats’ nuisance behaviors, there appeared to be greater concern among participants for cat welfare. In line with this, compassion and the desire to alleviate suffering were most frequently noted as the motivation for feeding community cats, and participants emphasized that humane population control measures were of high priority. Furthermore, a discursive construction that emerged was cats as blameless victims of human negligence in need of care. This echoes interview findings from southern Ontario where feral cats were frequently characterized as suffering abandoned pets in need of rescue (7, p. 10).

In terms of the source of community cat issues, participants primarily identified irresponsible pet ownership as the root cause (including not spaying/neutering cats, letting them roam outdoors, and abandoning them). This may explain why responsible pet ownership education received high levels of support on the survey (90%; 8). According to a national survey conducted in 2008, less than 24% of cats in Canada are purchased from reputable sources, limiting owners’ access to pet care information, which could contribute to cat overpopulation issues (3). Interestingly, rather than indicating that cat owners alone were responsible for solving community cat problems, many participants wrote that owners, the city, and the community have a responsibility for managing the issue together.

In terms of management strategies, although they were not listed as tools on the survey, a number of participants suggested bylaws such as mandatory cat licensing and a prohibition against free-roaming. These responses may have been influenced by discussions concerning the Guelph Animal Control Bylaw review, which engaged the public in consultation during 2014 to 2015. As a result of the review, mandatory cat licensing will be implemented in 2018 (25). It has been suggested that uneven companion animal legislation, such as requiring dogs to be licensed but not cats, may arise because dogs and cats are valued differently in our society (3). Future studies could investigate if the implementation of licensing or other bylaws result in altered cat ownership practices reflecting an increase in value, or in increased abandonment as some participants of this study feared.

While some participants were supportive of euthanasia because it was perceived as effective, others emphasized that while it may be effective, they would not support it, presumably for ethical reasons. Other respondents expressed that euthanasia was a drastic measure, which should only be considered as a last resort if other management strategies proved insufficient. This aligns with a broader trend in society towards reduced acceptance for the euthanasia of surplus companion animals (5). Furthermore, participants purported that euthanasia was not proactive or preventative. This opinion stemmed from the belief that new cats would move into the area (the vacuum effect) (5), or that it would perpetuate the status quo rather than change human attitudes and behaviors that result in owned cat abandonment and breeding, ultimately contributing to community cat populations. A survey of Canadians in 2008 found that 66% of participants obtained their cat for free, possibly contributing to the lower value placed on companion cats and their care (3). It has been suggested that TNR campaigns that include articles and flyers may provide educational opportunities to cat owners in the community, possibly contributing to improved responsible pet ownership practices over time (5).

Our findings demonstrate that participants may not support TNR due to perceived ineffectiveness, cost, or possible impacts on wildlife. Reasons for supporting TNR included the belief...
that it was a humane alternative to euthanasia, and perceived long-term effectiveness. Trap-neuter-return was also often suggested to be used in combination with other strategies, including accessible or low-cost spay/neuter, education, and euthanasia, demonstrating support for a multifaceted management approach.

As with many surveys, especially those conducted online, our sample is subject to self-selection bias (26,27). This is reflected in participant demographics, which are not representative of the population of Guelph. This is a limitation, in that the results of this analysis may not be generalizable to the broader community. However, the aim of this article was not to provide generalizable results, but to provide a more in-depth, nuanced understanding of participants’ perceptions and preferences to guide the future management of community cats in Guelph. Cat management efforts in Canada would benefit from future studies investigating the views and values of citizens towards community cats in other regions. Future studies could also explore public perceptions and preferences before and after the implementation of cat population management strategies such as education campaigns, accessible or low cost spay/neuter, or TNR.

Overall, this qualitative analysis highlights that participating Guelph residents give a high priority to proactive, humane management of community cats, and identifies opportunities for collaborative, multifaceted approaches. In terms of collaborative approaches, respondents expressed that the community needs to come together to solve the issue rather than relying on individualistic measures alone, such as pet owner actions and education. Furthermore, participants illuminated the opportunity for combining strategies to design a multifaceted approach. The city has already implemented cat licensing, which could be integrated with other well-supported measures such as accessible or low-cost spay/neuter and TNR. Collaborative, multifaceted approaches have been successful elsewhere, such as that developed by the Toronto Feral Cat TNR Coalition. The Coalition has brought together municipal animal control with humane and rescue groups to implement accessible spay/neuter clinics, education and training, and a centralized TNR program (28). The findings of this study will be used by the GCPT to continue advocating for research and action concerning community cat issues in Guelph.

Appendix I. Open-ended survey questions.

Open-ended Survey Questions

4. Please feel free to provide any other comments about your experience with Community Cats in Guelph
8. Are there other options that you believe would be effective to manage Guelph’s Community Cat Population?
10. Are there other management options that you would support?
11. Who do you think is responsible for causing Community Cat problems?
12. Who do you think should be responsible for solving Community Cat problems?
14. Please feel free to provide any other comments about your values or preferences concerning the management of Community Cats in Guelph.
22. Why do you feed Community Cats?

References

4. Blancher P. Estimated number of birds killed by house cats (Felis catus) in Canada. Avian Conserv Ecol 2013;8(3).
Exotic Animal Formulary, 5th edition


This formulary is an absolute necessity for any practitioner delving into the complex and still often poorly understood areas of exotic animal medicine. Regardless of whether you are working on rabbits, rodents, birds, or invertebrates, this book is an essential tool to practice medicine on these finicky creatures.

The main part of this book comprises the traditional formulary references for doses of common medications, hormones, and various supplements. There are also extensive sections with additional information including hematological and biochemical values, disinfectant choices, venipuncture sites, fluid therapy recommendations, suggested diets, cardiac measurements, and more. The book is organized by phylogenic chapters and then each chapter is broken down into tables of references.

This updated edition has more current recommendations and a larger list of specialist contributors. A section on backyard poultry and waterfowl and an expanded “selected topics for the exotic animal veterinarian” section have also been added.

While this reference is very reliable, all suggestions need to be taken into consideration with sound medical judgment and background knowledge of the species. The book provides doses found in primary literature rather than a single dosage option.

For example, doxycycline has 20 suggested doses for birds. This encompasses multiple routes of administration and many different species and groups of birds with unique requirements. Sometimes for a particular species and medication there simply may not be an established dose and the suggestion may include a wide reference range, a greater than or equal to sign, and even anecdotal advice. Always be careful to read the comments section for a particular dosage, as they can include important notes such as “did not achieve adequate plasma concentrations for analgesia,” an important factor to consider. In these cases, current knowledge of the species and clinical judgment of your patient is critical in deciding what to do. When there are doubts of a recommendation given or more information is necessary, every dosage is referenced in a section included at the end of each chapter.

The field of veterinary medicine is changing rapidly, especially in a world with increased exchange of information. The same can be said for the field of exotic animal medicine. It is near impossible for a practitioner to stay current on a few species alone, never mind the seemingly endless field of exotic animal medicine. This resource provides an up-to-date quick reference and, when in doubt, excellent references to primary literature.

Reviewed by Daren Mandrusiak, DVM, Park Veterinary Centre, Sherwood Park, Alberta.
The effect of intramuscular dexmedetomidine-butorphanol combination on tear production in dogs

Fabio Leonardi, Giovanna Lucrezia Costa, Alice Stagnoli, Elena Zubin, Paolo Boschi, Alberto Sabbioni, Barbara Simonazzi

Abstract — This study assessed the effects of a combination of dexmedetomidine and butorphanol on the Schirmer tear test I (STT I) values in dogs. Ninety-eight dogs were sedated with an intramuscular injection of a combination of dexmedetomidine, 5 μg/kg body weight (BW), and butorphanol, 0.2 mg/kg BW. The effects of dexmedetomidine were reversed by administering atipamezole at the end of the procedure. The combination of dexmedetomidine and butorphanol significantly decreased tear production 15 minutes after sedation. The STT I values 15 minutes after reversal of dexmedetomidine with atipamezole were significantly higher than the STT I values 15 minutes after sedation but were significantly lower than the STT I values before sedation. Gender, weight, duration of sedation, right or left eye did not affect STT I values after sedation. It is recommended that dogs sedated with a combination of dexmedetomidine and butorphanol be treated with a tear substitute to combat decreased tear production.

Résumé — Effet de l’association dexmédétomimidin-butorphanol intramusculaire sur la production lacrymale chez le chien. L’étude vise à déterminer les effets de l’association dexmédétomimidine-butorphanol sur les résultats du test de Schirmer I (STT I) chez le chien. Quatre-vingt-dix-huit chiens ont été sédatés avec l’association dexmédétomimidine (5 μg/kg) butorphanol (0,2 mg/kg) intramusculaire. La dexmédétomimidine a été antagonisée avec de l’atipamezole en fin de procédure. L’association dexmédétomimidine-butorphanol diminue significativement la production lacrimale 15 minutes post-sédation. Les valeurs de STT I 15 minutes post-antagonisation de la dexmédétomimidine étaient significativement plus élevées que celles de STT I 15 minutes post-sédation, mais significativement inférieures aux STT I pré-sédation. Les variables genre, poids, durée de la sédation, œil droit/gauche, n’ont pas significativement influencé les valeurs de STT I post-sédation. L’association dexmédétomimidine-butorphanol diminuant significativement leur production lacrimale il est recommandable de traiter les chiens avec des substituts lacrimaux pour éviter la sécheresse oculaire.

Can Vet J 2019;60:55–59

Introduction

The tear film allows the cornea to act as an optical surface for the refraction of light, allows the mechanical removal of debris and bacteria, and lubricates the conjunctiva and nictitating membrane (1). It contributes to the immunity of the ocular surface by releasing secretory immunoglobulin A, albumin, lipocalin, interleukins, and antibacterial compounds (lysozyme and lactoferrin) and plays an important metabolic role in bringing nutrients to the avascular portion of the cornea (1).

The Schirmer tear test (STT) is widely used in veterinary ophthalmology as a basic assessment of tear production. The STT I measures the basal and reflex tear production and is the most commonly used. The STT II measures basal tear production after the topical application of an anesthetic and is used in animals with corneal ulceration (1). Although STT I values greater than 25 mm/min may be physiologic in dogs, STT I measurements are commonly considered normal if they range within 15 to 25 mm/min (1).

In dogs, decrease in tear production is due to genetic (2), individual, or acquired factors (3), and medication. Antibiotics (4,5), nonsteroidal anti-inflammatory drugs, and anticholinergics reduce tear production and may cause corneal dryness in dogs (6–8). It is well-known that tranquilizers, sedatives, opioids, and general anesthetic drugs affect tear production and intraocular pressure in dogs and horses (9–12). Although
the decrease in tear production due to sedation or anesthesia is transient, it may lead to clinical disorders, such as corneal erosions and ulcers, which affect vision and cause discomfort (9).

Butorphanol is a κ-opioid receptor agonist and a μ-opioid receptor antagonist with analgesic and sedative properties. It induces mild or moderate sedation and causes minimal changes in cardiovascular function. A single dose of butorphanol of 0.5 mg/kg body weight (BW) significantly reduces tear production (10).

Dexmedetomidine is the dextrorotatory S-enantiomer of medetomidine and has sedative and analgesic properties (13). This drug was developed to reduce the side effects of medetomidine. In fact, even though the levorotatory isomer is not pharmacologically active, it influences the pharmacokinetics and pharmacodynamics of dexmedetomidine. The absence of the levorotatory isomer reduces the hepatic metabolic load and side effects (14). Nevertheless, the dextrorotatory isomer causes bradycardia, decreases cardiac output, and increases systemic vascular resistance (13). In dogs, dexmedetomidine causes miosis following direct inhibition of parasympathetic stimulation of the iris and reduces intraocular pressure by the activation of the α2 receptors in the iris (15).

The combination of an α2-agonist with butorphanol provides deep sedation for diagnostic and clinical procedures that is completely reversible with the use of antidotes (16). The combination of medetomidine and butorphanol significantly decreases tear production in dogs (17) but, the authors are not aware of any data on the effect of the pharmacologically active dextrorotatory isomer of medetomidine used in combination with butorphanol on aqueous tear production. The aim of this study was to evaluate the effect of a combination of dexmedetomidine and butorphanol on tear production as assessed with the Schirmer tear test I (STT I) in dogs and to evaluate the influence of gender, weight, duration of sedation and right or left eye on the STT I values after sedation.

Materials and methods

Animals

The study was performed in accordance with Legislative Decree n. 26 from March 4, 2014, under Italian Animal Welfare Legislation. The owners signed a voluntary informed consent form before enrollment of the dogs.

The inclusion criteria for this study were: patients undergoing a clinic visit, radiologic or ultrasonographic assessment, age > 1 y, no history of previous ocular disease, and no drug therapy, sedation, or anesthesia in the previous 3 mo.

Ophthalmic examination

An ocular examination was performed before sedation in an enclosed space under the same conditions of light, temperature (20°C), and relative humidity (55%). It consisted of a Schirmer tear test I (STT I) and a slit lamp examination (KOWA SL-17, Düsseldorf, Germany). The same experienced veterinarian performed all the ocular examinations, and the same Schirmer tear test I strips (Schirmer tear test; Schering Plough, Milan, Italy) were used. The strip was inserted into the lateral third of the inferior conjunctival fornix and was adhered to the cornea to avoid interference of the nictitating membrane for 1 min in each eye. Dogs with abnormalities of the ocular surface or with STT I values lower than 15 mm/min or higher than 25 mm/min (in compliance with the product labeling of the STT I strips used) were withdrawn from the study.

The STT I measurements were performed before sedation, 15 min after administration of the combination of dexmedetomidine and butorphanol, and 15 min after the injection of atipamezole. All the STT I measurements were recorded between 8:00 am and 12:00 am.

Sedation protocol

Dogs underwent physical examinations in order to classify them according to the American Society of Anesthesiologists (ASA) physical status classification system. Dogs with an ASA status ≥ 3 were withdrawn from the study.

Dogs were sedated with an intramuscular (IM) injection of dexmedetomidine (Dexdomitor; Orion Pharma, Milan, Italy), 5 μg/kg BW, combined with butorphanol (Dolorex; Intervet, Milan, Italy), 0.2 mg/kg BW, into the quadriceps muscle. The action of dexmedetomidine was completely reversed by administering atipamezole (Atipam; ATI, Ozzano dell’Emilia, Bologna, Italy), 50 μg/kg BW, into the quadriceps muscle at the end of the procedure. The duration of sedation, which was defined as the time from the administration of sedation to the injection of atipamezole, was recorded.

Data analysis

The data were analyzed with analysis of variance (ANOVA) by means of the general linear model (GLM) procedure in SAS (Version 9.4, 2012; SAS Institute, Carey, North Carolina, USA) (18); the fixed factors included sedation (before sedation, 15 min after sedation, and 15 min after the administration of atipamezole), gender (intact females, spayed females, intact males, neutered males), body weight (< 10 kg, 10 to 19.9 kg, 20 to 29.9 kg, and ≥ 30 kg), right or left eye, duration of sedation (< 60 min or ≥ 60 min), and age (0 to 8 years). The interaction effect of all factors was tested and only when it was significant was the main effect considered. If significant differences were found, the Dunnett multiple comparison test was performed (two-tailed). All data were presented as mean ± standard deviation.
Table 2. STT I values (mm/min) related to gender, eye, body weight, and duration of sedation.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Before sedation</th>
<th>15 min after sedation</th>
<th>15 min after atipamezole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intact females</td>
<td>20.84 ± 0.49</td>
<td>10.07 ± 0.56</td>
<td>13.84 ± 0.59</td>
</tr>
<tr>
<td>Spayed females</td>
<td>22.07 ± 0.39</td>
<td>9.42 ± 0.45</td>
<td>14.09 ± 0.48</td>
</tr>
<tr>
<td>Intact males</td>
<td>21.49 ± 0.39</td>
<td>9.68 ± 0.43</td>
<td>14.72 ± 0.46</td>
</tr>
<tr>
<td>Neutered males</td>
<td>21.88 ± 0.42</td>
<td>9.63 ± 0.48</td>
<td>13.46 ± 0.51</td>
</tr>
</tbody>
</table>

Table 3. Aqueous tear production as evaluated with STT I (mm/min) before sedation, 15 min after sedation with a combination of dexmedetomidine and butorphanol, and 15 min after the injection of atipamezole.

<table>
<thead>
<tr>
<th>Before sedation</th>
<th>15 min after sedation</th>
<th>15 min after atipamezole</th>
</tr>
</thead>
<tbody>
<tr>
<td>STT I values (mm/min)</td>
<td>21.53 ± 0.24</td>
<td>10.03 ± 0.24</td>
</tr>
</tbody>
</table>

Results

Ninety-eight dogs met the inclusion criteria of the study. The dogs belonged to 33 breeds; their physical characteristics are reported in Table 1. The mean duration of sedation was 52.57 ± 11.41 min (Table 1). No side effects were recorded in the sedated dogs. All patients recovered and were ambulatory within 15 min after the administration of atipamezole.

Before sedation, the STT I values were significantly higher ($P = 0.03$) in intact females than in spayed females (Table 2). There were no significant differences with regard to the right or left eye and body weight before sedation (Table 2). Fifteen minutes after sedation, the STT I values were significantly ($P = 0.0001$) decreased (Table 3) and there were no significant differences in the STT I values related to gender, right or left eye or body weight (Table 2).

Fifteen minutes after the injection of atipamezole, the STT I values were significantly higher ($P = 0.0001$) than the STT I values 15 min after sedation, but were significantly lower ($P = 0.0001$) than the values before sedation (Table 3); there were no significant differences in the STT I values related to gender, right or left eye, body weight, or duration of sedation (Table 2). Fifteen minutes after the injection of atipamezole, the STT I values were significantly lower in dogs weighing 10 to 19.9 kg compared to dogs weighing < 10 kg ($P = 0.0056$) and those weighing 20 to 29.9 kg ($P = 0.0011$) (Table 2).

Discussion

This study showed that administration of a combination of dexmedetomidine and butorphanol is associated with decreased aqueous tear production in dogs. Fifteen minutes following the administration of atipamezole, tear production increased, but the STT I values stayed below 15 mm/min even if dogs were able to walk.

Environmental and individual factors affect tear production (18–20). To reduce the influence of the ambient conditions, all the STT I measurements were performed under the same environmental conditions between 8:00 am and 12:00 am, even though the time of day does not appear to affect the STT I values in normal dogs (20,21). Dogs with an ASA status ≥ 3 were excluded because a high ASA status often implies a greater degree of nociception. Pain pathways may alter functions of various organs and systems.
including the lacrimal apparatus (16), and it is not possible to predict the effects of the pain on aqueous tear production. Additionally, a poor physical status increases anesthetic risk and a dexmedetomidine-butorphanol combination is not indicated for high-risk patients because it may lead to significant cardiac, hemodynamic, and respiratory side effects (14,16).

Many reports proved that butorphanol, medetomidine, and combinations of these medications significantly reduce tear production (10,17,22). Medetomidine is a mixture of 2 optical enantiomers, dexmedetomidine and levomedetomidine. Levomedetomidine reduces the sedative and analgesic effects of dexmedetomidine and increases bradycardia (13,14). Consequently, the administration of dexmedetomidine alone may have some cardiovascular benefits over the administration of medetomidine (13). Based on the pharmacodynamics of dexmedetomidine and considering the low dose of butorphanol used in the present report compared with previous studies (10,17), we assumed that the combination of dexmedetomidine and butorphanol would not affect tear production. In contrast, our results highlight a significant reduction in aqueous tear production. A probable reason for the decreased measurable tear production is the evaporative loss caused by the sedative effects of the combination of dexmedetomidine and butorphanol, which reduces blinking (16). Therefore, the aqueous layer of the tear film can evaporate more.

Based on a previous report that demonstrated that the combination of morphine with acepromazine altered canine lacrimal gland metabolism (9), another explanation for the reduction in the STT I values is a potential alteration in the metabolism of the lacrimal glands. Nevertheless, in our opinion, the neurophysiological mechanisms and hemodynamic changes were the most likely causes of the reduction in the tear film. We suggest that the postsynaptic activation of \( \alpha \)-adrenoceptors in the central nervous system (CNS) due to dexmedetomidine and the changes in sympathetic activity due to butorphanol may have decreased basal tear production (10,23–25). Furthermore, the reduction in the STT I values could also be due to the decrease in reflex tear production mediated by diminished nociceptive transmission. In fact, \( \alpha \)-2-agonists modulate the transmission of nociceptive signals in the CNS, and opioids synergistically act by reducing nociceptive transmission (26).

Dexmedetomidine and butorphanol cause systemic and local hemodynamic changes (10,14,16,22). Dexmedetomidine commonly induces a decrease in heart rate and blood pressure, whereas butorphanol alone is responsible for small decreases in heart rate and blood pressure (14,16). The combination of an \( \alpha \)-2-agonist with an opioid synergistically affects hemodynamic parameters (26). Thus, it is likely that the combination of dexmedetomidine and butorphanol induces mild hypotension that is responsible for decreased perfusion of the lacrimal glands followed by a consequent decrease in aqueous tear production.

We cannot clearly ascribe the increased STT I values to the reversal of the sedative effects of dexmedetomidine with atipamezole. Nevertheless, based on the dose-dependent duration of the sedative effect of dexmedetomidine (13,14), it is likely that the effect of dexmedetomidine was still present when atipamezole was administered. Consequently, the reversal of dexmedetomidine sedation with atipamezole is a possible reason for the increased measurable tear production.

Based on the duration of action of butorphanol (16), it is likely that the effect of butorphanol was still present after the administration of atipamezole. Therefore, the STT I values after the administration of atipamezole that were lower than baseline values highlight the fact that butorphanol plays an important role in decreased tear production. The pharmacokinetics of butorphanol suggest that the STT I values can return to baseline values within 3 to 4 h after sedation (10,16).

Breed, age, gender, and weight may affect aqueous tear production (3,19,24). The influences of breed and age could not be evaluated herein because of the heterogeneous sample. To limit the influence of age, we included dogs that were older than 1 y because only these patients have complete physiological blinking and regular tear production.

The influence of gender on tear production has been widely discussed by researchers. In humans, aqueous tear production decreases after menopause in women (27), and the use of antian- drogenic substances predisposes men to dry eyes (28). Neutered dogs of both sexes show decreased tear production, whereas only spayed females show a higher incidence of keratoconjunctivitis sicca (18). In the present study, gender did not influence changes in the STT I values, but spayed females showed higher basal STT I values and a more marked reduction in tear production than did intact females. Therefore, it is likely that canine sex hormones may affect basal tear production, but further studies are needed.

Regarding body weight, the veterinary literature has reported greater tear production in heavier dogs than in lighter ones (18). In the present report, this variable did not affect either baseline STT I values or decreased STT I values after sedation. Surprisingly, after the administration of atipamezole, the STT I readings showed significant differences between the body weight classes. We suggest that tear production may have been affected by the different body composition rather than the body weight. Canine breeds show marked differences in percentages of body fat even when the body condition score and body weight are the same (29). The amount of fat influences drug metabolism, recovery from sedation, and all the effects caused by the sedation protocol, including reduced tear production (30).

In conclusion, the combination of dexmedetomidine and butorphanol was associated with decreased aqueous tear production and differences in the STT I values were not related to gender, weight, duration of sedation, and right or left eye. Reversal of dexmedetomidine with atipamezole is associated with increased values, but the STT I readings do not return to baseline values. Therefore, it is recommended that dogs be treated with a tear substitute to combat a significant reduction in tear production associated with sedation using intramuscular dexmedetomidine and butorphanol. Tear substitutes must be administered just before sedation and after recovery.

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References
Lung lobe torsion in 35 dogs and 4 cats
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Abstract — The purpose of this study was to assess survival to discharge of animals with surgical or postmortem confirmation of a lung lobe torsion (LLT) as well as to evaluate pre-operative effusion, lung lobe affected, and patient size as prognostic indicators. Medical records search identified 35 dogs and 4 cats with a confirmed diagnosis including 17 small-breed dogs, 18 large-breed dogs, 3 domestic shorthair cats, and 1 minskin cat. Lobes affected included right middle ($n = 18$), left cranial ($n = 18$), right cranial ($n = 2$), left caudal ($n = 1$), and accessory ($n = 1$). Two animals died before surgery; the remaining 37 animals underwent thoracotomy. All treated small-breed dogs and cats survived; 12/18 large-breed dogs survived, with an overall survival to discharge of 87%. Pre-operative pleural effusion and affected lung lobe did not affect survival to discharge in this population. Small dogs and cats with LLT appear to have an excellent survival to discharge following thoracotomy and the survival is good in larger dogs.

Résumé — Torsion de lobe pulmonaire chez 35 chiens et 4 chats. Le but de cette étude est d’évaluer le taux de survie jusqu’à la sortie d’hôpital, chez des animaux ayant eu confirmation chirurgicale ou post-mortem de torsion de lobe pulmonaire (TLP), ainsi que d’évaluer la présence d’épanchement pleural, le lobe pulmonaire affecté et la taille des patients en tant que facteurs pronostics. Les dossiers médicaux de 35 chiens et 4 chats avec un diagnostic de TLP confirmé furent identifiés, comprenant 17 chiens de petite race, 18 chiens de grande race, 3 chats Européens et 1 Minskin. Les lobes pulmonaires affectés étaient le lobe moyen droit ($n = 18$), le lobe cranial gauche ($n = 18$), le lobe cranial droit ($n = 2$), le lobe caudal gauche ($n = 1$) et le lobe accessoire ($n = 1$). Deux chiens décédèrent avant chirurgie, et une thoracotomie fut pratiquée chez les 37 animaux restant. Tous les chiens de petites races et les chats survécurent à leur chirurgie; 12/18 des chiens de grande race survécurent, et le taux de survie global était de 87 %. La présence d’épanchement pleural et le lobe pulmonaire affecté n’avaient pas d’influence sur la probabilité de survie dans cette population. Le taux de survie au congé hospitalier semble excellent chez les chiens de petite taille et les chats diagnostiqués avec une torsion de lobe pulmonaire et il est bon pour les chiens de grande taille.

Introduction

Lung lobe torsion (LLT) is uncommon in dogs and rare in cats, although it is commonly suggested as an important differential diagnosis following radiographic evidence of pulmonary consolidation (1–4). Lung lobe torsion occurs when a lung lobe twists on its pedicle, resulting in edema, emphysema, and necrosis of the lung lobe. Treatment of LLT includes most commonly a lateral thoracotomy and removal of the affected lobe. Median sternotomy may be performed if definitive diagnosis or the lung lobe affected is unclear, or if there is bilateral thoracic involvement. Like isolated splenic torsion, it is important that lobes are not untwisted before resection to avoid release of inflammatory cytokines and toxins (5).

Lung lobe torsion has been documented in both small and large breed dogs with pugs and Afghan hounds being over-represented (2,3). It has been suggested that, similar to the proposed mechanisms for gastric dilatation and volvulus, deeper-chested dogs may have more room in their thoracic cavity to allow for the lungs to shift and subsequently torque (2). In a study by Murphy and Brisson (3), 13/23 affected dogs were...
small breed, with pugs representing 7/13 (54%) of those dogs. No other specific breed predilections have been reported, nor has impact of breed or size on survival to discharge been previously evaluated. Lung lobe torsion is far less common in cats, in which it has been associated with chronic upper respiratory infection, asthma, diaphragmatic hernia, chylothorax, and neoplasia (6–11).

Diagnostics performed most commonly to identify LLT include thoracic radiographs, and abnormalities reported radiographically include increased lobar opacity or consolidation, vesicular gas pattern, displaced lung lobe or lobar bronchus, progressive bronchial opacification, mediastinal shift, tracheal displacement, axial rotation of the carina, irregular, narrowed, or blunted bronchus, and pleural effusion (1). Chronic pleural effusion has been considered a risk factor for the development of LLT, although primary LLT itself may trigger accumulation of pleural effusion due to associated necrosis and inflammation (2,3).

The goal of this study was to describe the clinical characteristics and survival to discharge of dogs and cats which develop LLT, specifically, to evaluate if pre-operative pleural effusion, lung lobe affected, or animal size has an effect on survival to discharge.

Materials and methods

Case selection criteria and medical records review

The electronic medical record database for the Cummings School of Veterinary Medicine at Tufts University was searched from January 1, 2002 to December 31, 2016 for “lung lobe torsion” and each medical record was reviewed. Animals were included if they had a confirmed diagnosis of LLT at the time of thoracotomy or necropsy regardless of any other patient characteristics. The medical records were reviewed and data recorded on breed, age and weight at presentation, gender, affected lung lobe, diagnostic imaging modalities used and imaging reports in the medical record, presence of pre-operative pleural effusion, presence of fever at presentation, surgical approach for animals undergoing surgery, peri-operative complications, potentially predisposing conditions, if any identified, and survival to discharge. Complete imaging reports for studies not performed at Tufts University were not included in the medical records and these images were not available for further review at the time of this retrospective study. Predisposing conditions included any disease predisposing a patient to pleural effusion, the presence of pleural effusion, or a history of thoracic trauma (2). Dogs were considered small breed if they weighed < 15 kg consistent with that used in a previous study (3). The institutional Animal Care and Use Committee approval and owner consent were waived due to the retrospective nature of the study.

Statistical analysis

Fisher’s exact test was used to compare survival to discharge based on patient size, lung lobe affected, surgical approach, number of surgeries performed, and presence or absence of pre-operative pleural effusion with a P-value < 0.05 considered significant. Odds ratios (OR) and 95% exact confidence intervals (CI) were calculated for each association.

Results

Signalment

Over the study period, 35 dogs and 4 cats met the inclusion criteria. Of the affected dogs, 10 (29%) were pugs, 8 (23%) were mixed breed, 2 (6%) each were Great Pyrenees, golden retriever, and Labrador retriever, and 1 (3%) each was a collie, Bernese mountain dog, boxer, English bulldog, Irish wolfhound, English springer spaniel, toy poodle, cocker spaniel, Pekingese, Lhasa apso, and French bulldog. Seventeen (49% of dogs) were small breed, and 18 (51% of dogs) were large breed, including 6 of the mixed breed dogs. Of the affected cats, 3 were domestic shorthairs and 1 was a minskin (12). Eighteen animals were castrated males, 17 were spayed females, 3 were intact males (including a 4-month-old Labrador retriever and a 5-month-old Great Pyrenees), and 1 was an intact female (French bulldog). Seven of the 10 affected pugs were male. Median age was 4 y (range: 4 mo to 12 y).

Presenting complaint and history

Presenting complaints included anorexia or decreased appetite (n = 23), respiratory distress (n = 20), lethargy (n = 16), cough (n = 13), tachypnea (n = 10), vomiting (n = 5), gagging (n = 2), weight loss (n = 2), and collapse (n = 1). Duration of clinical signs was both acute and chronic ranging from < 12 h to up to 3 mo. Thirteen animals (33%) also had a documented fever (temperature > 39.4°C), at the time of presentation. Eleven animals (28%) had received antimicrobials before confirmation of LLT. Three animals (8%) sustained vehicular trauma at 2, 3, or 5 wk before presentation and all 3 had a diaphragmatic hernia and pleural effusion identified on pre-operative imaging or at the time of thoracotomy in addition to the LLT. Cats and dogs appeared to display similar clinical signs. All cats and all but 3 dogs were presented with complaints of respiratory compromise including tachypnea, respiratory distress, and cough. The 3 dogs without respiratory signs had a combination of anorexia, lethargy, and fever and duration of clinical signs ranging from 3 to 10 d.

Diagnostic imaging: Thoracic radiographs

All 39 animals had thoracic radiographs taken within 72 h of initial presentation to Tufts University or their primary care veterinarian. Twenty-six animals had radiographs taken and interpreted by the diagnostic imaging service at Tufts University, while 13 animals had radiographs taken at their primary care veterinarian before referral. For the 26 animals with radiography done at Tufts University, the most commonly documented radiographic abnormalities included pulmonary consolidation (n = 26), pleural effusion (n = 20), vesicular pattern of an individual lung lobe (n = 14), and lack of visualization of the bronchus or vasculature within the affected lung lobe (n = 12) (Figures 1 and 2). Of these 26 animals, 15 had LLT as the primary differential diagnosis and 7 were considered to have LLT as a differential diagnosis. In the other 4 animals, LTT was not suspected based on radiographs, although 3 had pleural effusion...
obscuring visualization of the lung lobes and 1 had a large volume pneumothorax. Interestingly, in only 2 of the 4 cats was LLT suspected based on radiographs alone. Thirteen animals had thoracic radiographs taken at their primary care veterinarian with 8 of these cases suspected of having an LLT either by the referring veterinarian, admitting clinician at Tufts University, or a Tufts University radiologist. Overall, of 39 animals with thoracic radiography, LTT was suspected in 30 cases.

Diagnostic imaging: Computed tomography
Eighteen animals (46%) had computed tomography (CT) performed either to confirm the presence of LLT before surgery, for surgical planning, or to exclude concurrent pathology. The most common findings on CT scan included pulmonary consolidation ($n = 18$), pleural effusion ($n = 15$), abnormal tapering or blunting of the bronchus ($n = 15$), vesicular pattern ($n = 12$), lack of visualization of the bronchus or vasculature within the affected lobe ($n = 8$), decreased or absent contrast enhancement ($n = 8$), and enlargement of the affected lobe ($n = 7$) (Figures 3–5). Following CT, 15 animals were identified with LLT, and 2 animals had LLT as the leading differential diagnosis. The 1 remaining dog was thought to have a cavitated, gas-filled, caudal thoracic mass on CT, and LLT was not suspected until it was identified surgically.

Other diagnostic modalities
Eight animals (21%) had bronchoscopy performed, with 4 pugs suspected of having LLT based upon radiographs having the diagnosis confirmed on bronchoscopy alone. The choice to perform bronchoscopy in the pugs for confirmation of LLT was due to the quickness with which the procedure can be performed prior to surgery and the higher frequency with which pugs are affected with LLT, thus increasing the likelihood of confirming a diagnosis with bronchoscopy alone. Findings consistent with LLT were seen in all 8 animals on bronchoscopy and included a folding or pinching of the bronchus and inability to advance the scope into the affected lung lobe (Figure 6). Two dogs and 1 cat had thoracic ultrasonography with both color doppler and standard 2D images obtained; 1 study only documented pulmonary consolidation with severe pleural effusion, and the remaining 2 studies suggested a pulmonary mass or abscess. These studies were helpful in confirming the presence of
pulmonary pathology, but did not further characterize the patient as having an LLT.

**Affected lung lobes**

Lung lobes affected included the right middle ($n = 18$), left cranial ($n = 17$), right cranial ($n = 2$), left caudal ($n = 1$), and accessory lobe ($n = 1$) (Figure 7). Eight of 10 pugs (80%) had left cranial LLTs and 2 had right cranial LLTs. Fourteen of 18 large breed dogs had right middle LLTs which accounted for the majority (78%) of all right middle LLTs. The single left caudal LLT was in a domestic shorthair cat and the accessory LLT was in the English bulldog. Four of the remaining non-pug small breed dogs had left cranial LLTs and 3 had right middle LLTs.

**Pleural effusion**

Thirty-five animals (90%) had pleural effusion at presentation or developed effusion before surgery. Of animals that were treated surgically with pre-operative pleural effusion, 27/33 survived to discharge; all 4 animals without pre-operative pleural effusion survived, but this difference was not significant ($P = 0.59$; OR: $\infty$; 95% CI: 0.12 to $\infty$). When comparing the 2 most commonly affected lung lobes, the right middle LLT was more commonly associated with pre-operative pleural effusion than was the left cranial LLT based on the Fisher exact test, but not based on the OR 95% CI (18/18, 100% versus 13/17, 76%, $P = 0.04$; OR: $\infty$; 95% CI: 0.76 to $\infty$), and a cause for this disparity was not identified.

**Surgical intervention**

Following diagnosis, 37 animals were treated with surgical removal of the affected lobe. Thirty-one (84%) had a lateral thoracotomy performed (15 right-sided, 16 left-sided) and 6 (16%) had a median sternotomy. The surgical approach was dictated by lung lobe affected, concurrent disease in the case of patients with diaphragmatic hernia, and surgeon preference.

**Survival to discharge**

One small breed dog was euthanized before surgery due to significant co-morbidities, including pleural effusion believed to be caused by a cranial vena cava thrombus associated with a transvenous pacemaker lead wire and 1 cat arrested after thoracocentesis due to a tension pneumothorax. Both animals which died before surgery had the diagnosis of LLT confirmed on postmortem examination. The cat was also identified to have a pulmonary carcinoma in addition to the LLT. Among the remaining 37 animals treated surgically, all animals survived the initial surgery but only 31 animals (28 dogs and 3 cats) survived to discharge. Thirteen of eighteen (72%) patients with right middle LLT survived to discharge and 14/17 (82%) patients with left cranial LLT survived to discharge. Small breed dogs, including pugs, had significantly improved survival over large breed dogs (17/17, 100% versus 12/18, 67%, $P = 0.02$; OR: $\infty$; 95% CI: 1.33 to $\infty$).

Six animals (16%) died post-thoracotomy. One, previously proteinuric, dog developed anuric renal failure and died 2 d after surgery, and another, the adult Great Pyrenees, developed torsion of a remaining lobe and was euthanized 2 d post-surgery after the owners declined a second surgery. Four animals underwent an additional rescue thoracotomy between 1 and 6 d following initial surgical intervention due to either persistent pneumothorax ($n = 3$) or hemorrhage ($n = 1$). All 4 animals which underwent a second thoracotomy died; 2 of the 4 were euthanized within 24 h of the second thoracotomy due to persistent air leak, and 2 suffered cardiopulmonary arrest — one within 24 h of surgery and one 3 d after surgery.

Dogs with a history of traumatic diaphragmatic hernia were seemingly less likely to survive to discharge (1/3, 33%) compared to animals without trauma (30/34, 88%), but this did not reach statistical significance ($P = 0.06$; OR: 15; 95% CI: 0.57 to 912). Animals which had a median sternotomy as the initial surgical approach were significantly less likely to survive to discharge than those with a lateral thoracotomy, based on

![Figure 4. Axial CT image demonstrating soft tissue attenuation of the left cranial lung lobe (*) with inability to trace the bronchi of the cranial and caudal segments.](image)

![Figure 5. Transverse CT image demonstrating increased soft tissue attenuation in the region of the right cranial and right middle lung lobes with vesicular gas pattern (*).](image)
Fisher exact test, but not based on the OR 95% CI (3/6, 50% versus 28/31, 90%, \(P = 0.04; \) OR: 9.3; 95% CI: 0.79 to 101). Additionally, requiring a second surgery to control air leak or hemorrhage was also a negative prognostic indicator as all dogs did not survive, compared with animals that had only 1 surgery (0/4, versus 31/33, \(P < 0.01; \) OR: ∞; 95% CI: 5.3 to ∞).

**Discussion**

This study reviews the characteristics and survival to discharge of dogs and cats affected with LLT. As previously described, younger to middle-aged dogs are most commonly affected, but LLT can occur in dogs of any age. In a study, the median age for small breed dogs affected was 7 y (range: 1 to 10 y); the median age for large breed dogs was 3.5 y (range: 2 to 7 y) (3). All pugs in that study were 5 y old indicating this patient population may become affected at a younger age. Lung lobe torsion has been reported in other studies in dogs as young as 7 wk and as old as 14 y (2,13). In the current study, median age was 4 y, and 4 patients were < 1 y old. One Labrador retriever and 1 Great Pyrenees were 4- and 5-months-old, respectively, and 2 pugs were 8- and 10-months-old at the time of diagnosis. This is consistent with findings of a recent study of 7 juvenile dogs suffering from LLT (14) and emphasizes the importance of maintaining LLT as a differential diagnosis in young animals. The age range for affected pugs was 8 mo to 9 y (median: 2.5 y) with all but a single pug being < 6 y old, which is similar to previous reported findings (3,14).

Males appear to be over-represented in prior studies (2,3), but the case numbers were small in these studies as well as the current study. In this study, 21 animals (54%) were male with 7 pugs (70%) being male.

The most common presenting complaints observed in animals in this study were anorexia or decreased appetite and respiratory distress followed by lethargy, cough, and tachypnea. The duration of clinical signs for LLT is typically short, lasting from 1 to 3 wk, although in some cases, duration of clinical signs may be up to several months (2). In this study, the median duration of clinical signs before presentation was 6 d (range: < 12 h to 3 mo). Most animals (27/39, 69%) had clinical signs lasting ≤ 1 wk. Tachypnea and respiratory distress are the most common physical examination findings, though they are non-specific for LLT. Pale mucous membranes, abdominal discomfort, and fever may also be seen. In fact, fever was commonly identified in this study with a third of the patients having temperatures > 39.4°C. Fever has previously been reported in animals with LLT (2,3), and fever may prompt the clinician to consider pneumonia, particularly in the presence of pulmonary consolidation, which likely explains why many animals are often treated with antibiotics before identification of the LLT.

All animals had thoracic radiographs taken either at Tufts University or by their primary care veterinarian. Radiographs were considered diagnostic or suspicious for LLT in 30/39 cases (77%). A vesicular pattern, while typically associated with LLT (1), was only observed in 14/26 (54%) thoracic radiographs performed at Tufts University and in 12/18 (67%) CT scans, which is important, as the absence of a vesicular pattern does not exclude an LLT. A correct diagnosis of LLT was made following CT scan in 94% of cases. Computed tomography is likely more sensitive at identifying LLT in many cases due to its tomographic nature and the ability to more clearly visualize the pulmonary and bronchial structures without superimposition of concurrent pleural effusion. One dog in which CT did not accurately identify LLT had a torsion of the accessory lung lobe; the accessory lung lobe rarely torses (1–3,15), so this diagnosis was not suspected based upon CT.

Lung lobes affected are variable, with the left cranial lobe most commonly affected in pugs and the right middle lobe most commonly affected in large breed dogs (2,3). These findings were confirmed in the present study with the left cranial lobe affected in 80% of pugs and the right middle lobe affected in 78% of large breed dogs. However, the pathophysiology for development of LLT and why certain lobes are more commonly affected are poorly understood. Lung lobe torsion is thought to
be associated with consolidation or atelectasis of the affected lobe(s) and a subsequently more freely moveable lobe (1). The preclusion for different lobes to be affected may have to do with breed conformation or underlying cause (2,15); however, this could not be clarified from the current study. One study of bronchial abnormalities in brachycephalic dogs identified a higher rate of left cranial lobe collapse in pugs and suggested this anatomical variant may be relevant in the high frequency of LLT in this breed (16).

Overall survival to discharge was 87% which is improved from results reported in studies by Neath et al (2) and by Murphy and Brisson (3). Small breed dogs had a significantly improved survival compared with large breed dogs in this study. This is consistent with findings in a previous study (2) in which all 5 of the affected small breed dogs, including 2 pugs, survived. This is in contrast to the Murphy and Brisson study (3), in which the survival to discharge was 50% for both small and large breed dogs when pugs were excluded. In that study, 6/7 pugs survived, and in the current study, 10/10 pugs survived, supporting the previously suspected association with survival for pugs.

Pleural effusion is a common finding in animals with LLT, but whether it is a causative factor or is secondary to congestion and edema from the LLT is difficult to differentiate. Thirty-five animals (90%) in the current study had evidence of pleural effusion on imaging or at the time of surgery; however, in only 3 dogs was the presence of pleural effusion confirmed before the identification of LLT, including 1 dog with caval thrombosis associated with a pacemaker lead wire, 1 with chronic pleural effusion associated with protein-losing nephropathy, and 1 dog with mesothelioma. Conversely, in the Labrador retriever puppy being treated for suspected pneumonia, the absence of pleural effusion was documented, then within 12 h the puppy developed a large volume of pleural effusion and associated lung lobe torsion suggesting that pleural effusion could be either causative or a result of LLT, depending on the case. It is important to note that, in contrast to the study by Neath et al in 2000 (2), not all patients herein had pleural effusion, so the absence of pleural effusion must not be used to rule out LLT. When comparing the 2 most commonly affected lung lobes, the right middle LLT was more commonly associated with pre-operative pleural effusion than was left cranial LLT, but a cause for this disparity was not identified. The right middle lung lobe is considered the most mobile (15), so it may be more likely to result in pleural effusion when torsed or be the first lobe to tors in the presence of pleural effusion.

For surgical approach, most of the animals (84%) had a lateral thoracotomy to gain access to the affected lobe. Six animals (16%) had median sternotomies performed either because multiple lung lobes appeared to be affected or due to concurrent disease. Such was the case of 1 animal with a history of trauma and recently corrected diaphragmatic hernia to allow for exposure of all lung lobes to assess for any other undiagnosed thoracic injury. Animals which had a median sternotomy as the initial surgical approach may have been less likely to survive to discharge than those with a lateral thoracotomy, although statistical significance is uncertain based on the OR 95% CI. Furthermore, if true, this association may be, at least in part, a manifestation of concurrent disease such as previous thoracic trauma and not the result of surgical approach alone. A recent study compared short-term outcomes in dogs with median sternotomy versus intercostal thoracotomy for lung lobectomy (17). This study reported that a median sternotomy had increased post-operative hypoxemia and a trend toward an increased rate of hemorrhage and/or death compared with lateral thoracotomy, so increased morbidity due to surgical approach could play a role in decreased survival. Four dogs needed a second surgical procedure due to tension pneumothorax or persistent hemorrhage following initial lung lobectomy. None of these dogs survived, which was statistically significant compared with dogs that only required a single surgery \( P < 0.01 \). To the authors’ knowledge, no previous studies have evaluated the effect of number of surgeries on survival to discharge for LLT.

The current study revealed a population of animals which developed LLT that, to the authors’ knowledge, has not previously been described; 3 dogs (8%) suffered from vehicular trauma and diaphragmatic hernia occurring 2 to 5 wk before the diagnosis of LLT. The diaphragmatic hernias are presumed to be initially acute secondary to the trauma, but all 3 of these dogs were present \( > 2 \) wk following the traumatic incident, classifying them as chronic at the time of surgery based on previous criteria used in an evaluation of chronic diaphragmatic hernias in dogs and cats (18). While thoracic trauma has been reported as a potential predisposing factor or cause for LLT (1–3), traumatic diaphragmatic hernia has not explicitly been shown to be a cause for LLT. There is a single case study of a Jack Russell terrier (19) that developed LLT 10 d following abdominal exploration and correction of a large diaphragmatic hernia, but this patient had no known history of trauma. The data available for these patients make it impossible to make a definitive causative association between traumatic diaphragmatic hernia and LLT. All dogs with traumatic diaphragmatic hernia also had large volumes of pleural effusion which may have predisposed them to development of the LLT. Alternatively, it is possible that the trauma itself resulted in both the diaphragmatic hernia and lung lobe torsion and subsequent formation of effusion. For dogs with trauma, the right middle \( (n = 2) \) and left cranial \( (n = 1) \) lobes were affected and all were large breed dogs. The survival rates reported by Minihan et al (18) for surgical repair of chronic diaphragmatic hernias are better than those in this study (86% versus 33%), which may indicate increased mortality associated with the LLT or differences in study populations.

The surgical procedure recommended for treatment of LLT in animals is thoracotomy with resection of the affected lung lobe. In human medicine, LLT is primarily a post-operative complication following upper lung lobectomy and most commonly affects the right middle and left lower lobes (20,21), though it can be seen with thoracic trauma, large volume pleural effusion, or other invasive thoracic procedures. To minimize this risk of torsion following lung lobectomy in humans, clinicians describe surgical pexy of the remaining lobes (20,22,23) by various methods including use of a pleural flap, suturing lung to adjacent structures in the thorax, suturing the middle and lower...
lobes together, and the use of various medical grade adhesive materials. Post-surgical LLT is rarely recognized in dogs. In the current study, there was a single dog which developed additional LLT (identified on CT) of the right middle and right cranial lung lobes following surgical resection of a left cranial LLT and an initial good recovery. This dog was euthanized at the time of the second torsion and may have benefited from surgical pexy. Criteria have not been established for determining which animals, if any, are at increased risk for LLT following lung lobectomy and would benefit from lung pexy. Further veterinary studies on the safety and efficacy of lung lobe pexy are needed to determine if this would be of benefit in cases of lung lobectomy following lung lobe torsion. No recommendation can be made at this time concerning lung lobe pexy as a viable option for this patient population.

This study was limited by the retrospective study design and incomplete medical records, primarily pertaining to history and the possibility of any predisposing factors as well as conclusive radiographic findings for animals that did not have imaging performed at the teaching hospital. Reported findings for thoracic radiographs may have been skewed by incomplete documentation by the primary clinician of the findings on radiographs performed at primary care hospitals before referral. For those imaging studies performed at Tufts University, only the reports and not the individual images obtained were reviewed at the time of this study. Radiographic and other diagnostic imaging findings may have been biased by multiple reviewers instead of a single specialist reviewing all imaging. Furthermore, only short-term outcome (e.g., survival to discharge) could be ascertained as follow-up records were not available long-term for most animals. Finally, the small sample size of this study and in particular, the very small sample size of some of the analyzed groups may infer a significant bias, and results may not be corroborated when applied to the general population.

In conclusion, we found that lung lobe affected, and presence of pre-operative pleural effusion did not significantly affect survival to discharge for patients treated surgically for LLT in this population of dogs and cats. Small breed and large breed dogs were equally affected, but small breed dogs had significantly improved survival to discharge. As with other studies, pugs were over-represented, making up over 25% of the patients. Surgical complications necessitating a second surgical exploration were associated with a grave prognosis. Overall, this study supported a good survival to discharge for LLTs treated surgically.

References
Effects of a surgical checklist on decreasing incisional infections following foreign body removal from the gastrointestinal tract in dogs

Zoë A. Launcelott, Jonathan Lustgarten, Jed Sung, Sirrika Samuels, Spencer Davis, Garrett J. Davis

Abstract — Two similar populations of dogs were evaluated in either a retrospective or prospective manner for 2 weeks after gastrointestinal foreign body surgery to determine the impact of a surgical checklist on the surgical site infection (SSI) rate. The medical records of 201 gastrointestinal foreign body surgeries were reviewed to determine the SSI rate without the use of a surgical checklist (SC−) and 101 consecutive gastrointestinal foreign body surgeries were performed using a surgical checklist (SC+). The SSI rate had a significant decrease from 19.9% to 11.9% with the use of the surgical checklist. When combining the cohorts, statistically significant predictors for development of an SSI following gastrointestinal foreign body removal included: a combined gastrotomy and enterotomy, an enterotomy, and known self-trauma.

Introduction

Surgical site infection (SSI) is one of the most common complications of abdominal gastrointestinal surgery (1). Bacterial contamination originates from the skin or the gastrointestinal tract with Staphylococcus pseudintermedius being the most commonly isolated organism from SSI in small animal veterinary patients (2–5). Although SSI is an inherent risk of any surgical procedure, SSIs are becoming more of a concern due to the increased prevalence of antimicrobial resistance (5,6).

As with any complicated task, it is easy to miss a step that would increase levels of bacterial contamination during gastrointestinal surgery to remove a foreign body. These surgeries have an inherent level of bacterial contamination due to entering the gastrointestinal tract and removing a foreign object (1,7). Bacteria can seed to the skin incision and lead to post-operative infection (1). The frequency of SSI can be decreased by the use of a surgical checklist designed to minimize the level of intra-operative contamination (5).

Checklists were first introduced in aviation in the 1930s to decrease human error as aircraft complexity increased (8). Checklists function as a support resource by outlining and categorizing items as a list; a format that simplifies conceptualization and recall of information (9). Proper methods for design and formatting are critical to an effective safety checklist and numerous resources and guides are available (9–11). The checklist provides a means for quick recall of critical information and current standards of care and should be designed based on the overall goals of any given department or procedure (9). There are many types of medical checklists (Table 1) and needs will dictate which type is used. Regardless of the type of checklist that is used, basic requirements include context, content, structure, images, and usability (9).
In 2008, the World Health Organization (WHO) developed the surgical safety checklist as a method to reduce complications and improve patient outcome in surgical patients (12). The checklist was designed as a verification tool to address critical actions while being concise, simple, and user friendly (12). Surgical site infection rates have been shown to decrease 3% to 10% after implementation of a surgical checklist in human and veterinary surgeries (13–16). There are more than 4000 hospitals in over 122 countries that are registered as users of the WHO checklist, indicating more than 90% of the world’s healthcare population have recognized its efficacy (8).

Infection can lead to increased patient morbidity and mortality, prolonged hospitalization, increased cost of treatment, and emotional strain (4,6,17–21). Published SSI rates in veterinary medicine range from 4.5% to 18% (4,17,18). Surgical checklists are intended to systematically enhance patient safety by reducing preventable medical errors (22). In 2008, a WHO pilot study on surgical safety checklists showed that surgical complications fell 36% in 3 mo (23). A recent veterinary study showed that the frequency of SSI and wound healing complications was significantly higher in animals that underwent surgery without a surgical safety checklist compared with those in which a checklist was used (16).

The purposes of this study were to i) determine if the use of a simple surgical checklist would decrease the post-operative SSI rate; and ii) identify risk factors for SSI following gastrointestinal foreign body surgery. We hypothesized that there would be fewer SSIs after implementation of a surgical checklist and that gastrointestinal procedures requiring greater intestinal manipulation (resection and anastomosis, combined gastrotomy and enterotomy) and those with self-trauma would result in a higher SSI rate.

### Materials and methods

Medical records from Red Bank Veterinary Hospital (RBVH) were reviewed to identify dogs surgically treated for foreign body removal before implementation of a surgical checklist, from April 2013 to September 2015. Patients were excluded if they had an incomplete surgery report, or if they did not have a 2-week follow-up appointment at either RBVH or their primary care veterinary hospital. A surgical checklist designed to decrease bacterial contamination was used prospectively in 101 consecutive foreign body surgery cases from January 2015 to March 2016.

The medical records for all cases were reviewed to determine: patient breed, age in years, weight (kg), gender status (female intact, female spayed, male intact, male castrated), surgical procedure performed (gastrotomy, enterotomy, combined gastrotomy and enterotomy, or resection and anastomosis), presence of a septic effusion, whether the foreign material was solitary or linear, length of surgery (min), length of anesthesia (min), whether the procedure was performed overnight (18:00 to 08:00) or during the day, the number of days of hospitalization, administration and type of postoperative antibiotics, any reported post-operative self-trauma, presence of an incisional infection, results of culture and sensitivity when performed, and selected hematologic variables (lactate, white blood cells, hematocrit, albumin, glucose, total bilirubin, and creatinine).

An incision was classified as having an SSI based on the standard definitions proposed by the Centers for Disease Control and Prevention (CDC) (24) with the timeframe being modified from 4 wk of the surgical procedure to 2 wk of the surgical procedure. The timeframe was modified due to routine follow-up for foreign body surgery being 2 wk at our institution and having a retrospective cohort.

The anesthetic protocol was based on the preference of the attending surgeon or anesthesiologist. After induction and clipping of the surgical site, the patient was moved into the operating room for aseptic preparation. For the SC− cohort, the abdomen was scrubbed with either diluted chlorhexidine solution or povidone iodine detergent followed by sterile saline. Cefazolin (West-Ward Pharmaceuticals, Eatontown, New Jersey, USA), 22 mg/kg body weight (BW), IV, was administered prophylactically to all patients before surgical incision; additional doses were administered every 90 min as needed until the end of surgery. Draping of the patient and preparation of the abdominal incision prior to incision into the intestinal tract for foreign body removal was done in an aseptic fashion specific to

### Table 1. Types of checklists (9).

<table>
<thead>
<tr>
<th>Type of checklist</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laundry list</td>
<td>Items, tasks, or criteria are grouped into related categories with no particular order.</td>
<td>Medical equipment checklist</td>
</tr>
<tr>
<td>Sequential or weakly sequential checklist</td>
<td>Grouping, order, and overall flow of the items, tasks, or criteria are relevant in order to obtain a valid outcome.</td>
<td>Procedure checklist</td>
</tr>
<tr>
<td>Interactive checklist</td>
<td>Items, tasks, or criteria on the checklist require repeated passes or review in order to obtain valid results, as early checkpoints may be altered by results entered in later checkpoints.</td>
<td>Cardiopulmonary resuscitation checklist</td>
</tr>
<tr>
<td>Diagnostic checklist</td>
<td>Items, tasks, or criteria on the checklist are formatted based on a “flowchart” model with the ultimate goal of drawing broad conclusions.</td>
<td>Clinical algorithm</td>
</tr>
<tr>
<td>Criteria of merit checklist (COM list)</td>
<td>Commonly used for evaluative purposes, in which the order, categorization, and flow of information are paramount for the objectivity and reliability of the conclusions drawn.</td>
<td>Objective structured clinical examination checklist</td>
</tr>
</tbody>
</table>
Sterile impermeable drapes used to wrap the instruments were used to collect the foreign material to prevent contamination of the drapes overlying the patient. After closure of the gastrointestinal incision, gloves and instruments were changed before routine closure. All surgeons prepared their hands with a hand scrub; either chlorhexidine (BDE-Z 107; Becton, Dickinson and Company, Franklin Lakes, New Jersey, USA) or povidone iodine (BDE-Z 205; Becton, Dickinson and Company) detergent scrub brushes or an antiseptic surgical hand scrub (Avagard; 3M Health Care, St. Paul, Minnesota, USA), and wore sterile cotton gowns and surgical gloves. Specific draping procedures and changing of gloves and instruments were not standardized among surgeons. All operating room personnel wore disposable caps and masks.

For the SC+ cohort, 5 steps were included in the surgical checklist (Figure 1) and each step was completed and checked off before proceeding with the next aspect of surgery. When adding a second drape before incising into the gastrointestinal tract, an impermeable drape was placed over the sterile field and an ‘I’ incision the length of the abdominal incision was cut into the drape. The edges were folded into the abdomen to protect the linea alba, subcutaneous tissue, and skin. The sterile impermeable drapes used to wrap the instruments were used in the same manner as was done for the SC− cohort to collect the foreign material. Once the foreign material was removed and the gastrointestinal incisions were closed, the drape with the ‘I’ incision was removed, a new sterile table was prepped, and gloves and instruments were changed before routine closure.

**Statistical analysis**

Data were tested for normality and within the current dataset, all variables measured were determined to be non-normal; a non-parametric approach was therefore used for statistical significance calculations. Median, quartiles, and ranges were calculated for all continuous variables. In the case of binary variables, the Binomial Distribution was used in comparison. For those variables that were continuous, the Mann-Whitney U-test was used. To address multi-hypothesis testing, the stringent Bonferroni correction that decreases the alpha proportionately to the number of variables being tested was used (25,26). Before correction, the alpha was set to 0.05 and all tests were evaluated using a 2-sided P-value. All statistical evaluations were performed using a statistical software program (SPSS 22 for PC; IBM, Armonk, New York, USA).

**Results**

Of 841 medical records reviewed, 201 animals met the study criteria for the SC− cohort. The 640 animals that were excluded did not have complete surgery reports, had surgery at a RBVH facility other than the Tinton Falls location, or were lost to follow-up. A total of 101 dogs with a surgical checklist were included in the SC+ cohort. The median age of all 302 dogs was 4.4 y (range: 5 mo to 15 y; 1Q 2 y, 3Q 7.8 y), and median weight was 23.2 kg (range: 1.2 kg to 88.5 kg; 1Q 12.6 kg, 3Q 32.6 kg). There were 108 females (8 sexually intact and 100 spayed) and 194 males (41 sexually intact and 153 castrated). There were 55 Labrador retrievers, 30 cross-breeds, 25 pit bull terriers, 21 golden retrievers, and 52 other breeds. The median surgical time was 70 min (range: 15 min to 220 min; 1Q 55 min, 3Q 95 min) and median anesthesia time was 90 min (range: 25 min to 250 min; 1Q 70 min, 3Q 110 min). Of the 302 animals in the study, 52/302 (17.2%) developed an SSI. Of the 201 SC− dogs, 40/201 (19.9%) developed an SSI and of the 101 SC+ dogs, 12/101 (11.9%) developed an SSI; the difference was statistically significant (P = 0.002). Culture and sensitivity results were available for 25/40 (62.5%) SC− and 4/12 (33.3%) SC+ for a total of 29/52 (55.8%) patients that were classified as having an SSI (Table 2). Of the available culture results, 17/29 (58.6%) contained mixed flora. The most common bacterial isolates were *Escherichia coli* (18/29, 62.1%) and *Enterococcus* sp. (17/29, 58.6%) followed by beta hemolytic *Streptococcus* (4/29, 13.8%). Every animal was administered antibiotics at induction, although patient preparation varied. In the SC− group, 55/158 (34.8%) and in the SC+ group 12/102 (11.8%), with available anesthesia charts, had surgeries longer than 90 min. Additional doses every subsequent 90 min were administered to 67/67 patients. There were 189 patients that received antibiotics after surgery, 34 (18%) of which developed an SSI. Of the 113 patients which did not receive antibiotics after surgery, 34 (18%) developed an SSI. When evaluating variables between the 2 groups, age in years, weight, gender status (female intact, female spayed, male intact, male castrated), gastrotomy, enterotomy, combined gastrotomy and enterotomy, presence of a septic effusion, linear foreign material, an overnight (18:00 to 08:00) or day procedure, administration and type of postoperative antibiotics, any reported postoperative self-trauma, lactate, white blood cells, albumin, glucose, total bilirubin, and creatinine all showed...
no statistically significant difference between SC− and SC+ patients. Resection and anastomosis (P < 0.001), solitary foreign material (P < 0.001), length of anesthesia (P < 0.001), the number of days of hospitalization (P < 0.001), length of surgery (P = 0.005), and hematocrit (P < 0.001) all showed a statistically significant difference between SC− and SC+ patients (Table 3).

Combined gastrotomy and enterotomy (P < 0.001), linear foreign body (P < 0.001), solitary foreign body (P = 0.003), enterotomy (P = 0.003) and known self-trauma (P = 0.001) were all statistically significant predictors for SSI development (Table 4). No significant correlation was found between SSI rate and weight, gender status, breed, gastrotomy; resection and anastomosis, length of surgery or anesthesia, length of hospitalization, receiving antibiotics after surgery, having septic effusion, or any of the studied hematologic variables when comparing SC+ and SC− groups.

### Discussion

Foreign bodies are the most common cause of gastrointestinal obstruction in small animal medicine (27). The results of the present study show that the overall SSI rate at our hospital after gastrointestinal surgery for foreign body removal was similar to the previously reported 4.5% to 18% SSI rate following clean contaminated and dirty procedures in veterinary studies (4,18).

After implementation of the surgery checklist, there was a statistically significant decrease in SSI rate overall (−8%, P = 0.002). There were no changes in operating room policies or personnel during the prospective part of the study, other than the surgical checklist, so differences in the frequency of SSI between the groups were attributed to implementation of the checklist. Checklists should be modified to suit any institutional, departmental, or patient need and allow a means for applying existing knowledge to achieve better outcomes for patients (23,28). Some steps on a checklist are considered obvious or routine but skipping or poorly performing one of these fundamental steps can lead to catastrophic results (23). The checklist used in this study was short, contained simple actions, and eliminated reliance on memory in hopes to reduce error. The checklist lead to increased communication among staff members, improved awareness, was easy to complete, and staff noted the steps became more routine as time went on.

Entering the gastrointestinal tract inevitably causes tissue trauma, requires tissue manipulation, and increases the chance of contamination of the surgical field. It is known that the degree of tissue trauma and systemic responses to stress are important factors in the etiology of SSIs (29–31). Celiotomy causes a reduction in lymphocyte and neutrophil chemotaxis, natural killer cell activity, lymphocyte and macrophage interactions, and delayed-type hypersensitivity responses, resulting in significant postoperative immunosuppression (30). Manipulation of the gastrointestinal tract during laparotomy elicits release of cytokines into the peritoneal fluid; the magnitude of cytokine release depends on the degree of surgical trauma, and surgical trauma is directly correlated with the degree and duration of deterioration of immune response after surgery (31). When contamination of the surgical field is combined with the patient’s decreased immunity, SSI is more likely. Examination of all the cases showed that there was a decrease in infection rate after removal of a solitary foreign body (−8.5%, P < 0.001), and after an enterotomy (−3%, P < 0.001). A surgical checklist cannot decrease tissue trauma or intestinal tract manipulation, but it ensures all the relevant perioperative controllable steps are completed in a timely fashion.

For the dogs that had known self-trauma 5/6 developed an incisional infection. It is difficult to know why veterinary patients inflict self-trauma. One explanation could be the normal healing processes and tissue contraction cause an unusual sensation that directs the animal’s attention to the incision. Another explanation could be that a subclinical infection is occurring, causing discomfort and therefore leading to self-trauma. With either situation, licking and scratching of the incision can lead to direct inoculation of bacteria, inflammation of the surgery site, and dehiscence. Local tissue defense mechanisms become impaired when there is chronic inflammation and disruption of the capillary network within the wounded tissue (29). Chronic inflammation results in prolonged elevation of pro-inflammatory cytokines and proteases, negatively affecting healing and decreasing the ability of the tissue to fight infection (32). The use of a protective device such as an Elizabethan collar is strongly recommended after any surgical incision.

Thirty-six percent (20/56) of patients that had a combined gastrotomy and enterotomy developed an incisional infection. There was no statistically significant difference in the SSI rate after implementation of the surgical checklist (P = 0.856); however, there was a 13.5% overall decrease. Although these results did not reach significance, this may be attributed to the sample size. Entering the gastrointestinal tract twice increases the chance of contamination, as do the degree of tissue trauma and manipulation. Most of these patients also had a linear foreign body which can be more challenging to remove, resulting in more contamination at the time of surgery. Results of this study, although not statistically significant (P = 1.000), revealed a 6.4% decrease in SSI rate for patients with a linear foreign body after implementation of the surgery checklist. A previous study (7) suggested that linear foreign bodies create a partial obstruction and thus patients are presented later in the course of their ailments. The delay in presentation can lead to increased damage to the intestinal tract and therefore increased local peritonitis and cytokine release decreasing immune function post-surgery (30,31,33).

This study showed no statistical significance between postoperative antibiotic groups and the development of an SSI

### Table 2. Culture results in SSI cases.

<table>
<thead>
<tr>
<th>Bacterial isolate</th>
<th>Number of cases</th>
<th>Overall percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Escherichia coli</em></td>
<td>18</td>
<td>62.1</td>
</tr>
<tr>
<td><em>Enterococcus</em></td>
<td>17</td>
<td>58.6</td>
</tr>
<tr>
<td>Beta hemolytic <em>Streptococcus</em></td>
<td>4</td>
<td>13.8</td>
</tr>
<tr>
<td><em>Enterobacter sp.</em></td>
<td>3</td>
<td>10.3</td>
</tr>
<tr>
<td><em>Proteus sp.</em></td>
<td>3</td>
<td>10.3</td>
</tr>
</tbody>
</table>

There were 1 each (3.5%) of *Klebsiella sp.*, *Bacillus sp.*, *Staphylococcus pseudintermedius*, *Myroides odoratimimus*, and *Morganella morgani*.
(P = 0.756) but showed a decreased SSI rate when antibiotics were not prescribed (8.1% versus 16.7%). Surgical patients that had dermatitis, had gross contamination during the procedure, or had severe intestinal trauma, were more likely to receive antibiotics, and this could have biased the results.

There were several limitations to this study. At our institution, routine follow-up for foreign body surgery is 2 wk with recommendation to schedule subsequent rechecks only if there are concerns. The retrospective nature of the SC—group, and only having records from the 2-week recheck, required modification of our definition for an SSI from the standard timeframe defined by the Centers for Disease Control and Prevention (24). In the records reviewed no patients had an additional follow-up at our facility within 2 wk after the initial re-check; however, because it was not mandatory, assumptions could not be made. The nature of the study also prevented us from standardizing the collection of cultures on incisional discharge and we relied on passive surveillance with dependence on the medical records. As many as 35% of SSI can be missed when relying on medical records alone (5). Active surveillance programs are the gold standard for establishing accurate SSI rates and understanding the factors that predispose to their occurrence (5,28). However, active surveillance programs require a significant investment in resources and are an operational challenge that is not feasible for all institutions (28). As alluded to by Turk et al (5), there is a need to develop a standardized method for categorizing and reporting SSI in medical records for more accurate passive surveillance. Another limitation has to do with the prospective aspect of the study. Checklists require communication between all team members leading to the inability to have a blinded cohort. The Hawthorne effect is well-known and concerns research participation, the awareness of being studied, and possible impact on behavior (34). Although this is of benefit for this study, as increased awareness is one of the goals of a safety checklist, it still leads to biased results. The final limitation is that the data were collected at a single institution and the same checklist, it still leads to biased results. The final limitation is that the data were collected at a single institution and the same

### Table 3. Median with ranges or counts of statistically significant variables between the checklist and no checklist groups regardless of surgical site infection.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Checklist</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resection and anastomosis</td>
<td>26/201 (12.9%)</td>
<td>2/99 (2.0%)</td>
<td>&lt; 0.001</td>
<td></td>
</tr>
<tr>
<td>Solitary foreign body</td>
<td>105/201 (52.2%)</td>
<td>75/101 (74.3%)</td>
<td>&lt; 0.001</td>
<td></td>
</tr>
<tr>
<td>Number of days in hospital</td>
<td>2 (1 to 13)</td>
<td>2 (1 to 5)</td>
<td>&lt; 0.001</td>
<td></td>
</tr>
<tr>
<td>Length of surgery (min)</td>
<td>75.00 (15 to 220.0)</td>
<td>60.00 (25.00 to 160.00)</td>
<td>0.005</td>
<td></td>
</tr>
<tr>
<td>HCT (%)</td>
<td>48.25 (18.3 to 69.6)</td>
<td>52.00 (3.80 to 74.40)</td>
<td>&lt; 0.001</td>
<td></td>
</tr>
</tbody>
</table>

HCT — hematocrit.

### Table 4. Comparison of the statistically significant variables leading to an SSI and the effects of a surgical checklist.

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Checklist</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>All procedures</td>
<td>40/201 (19.9%)</td>
<td>12/101 (11.9%)</td>
<td>-8.0%</td>
<td>P = 0.002</td>
</tr>
<tr>
<td>G &amp; E</td>
<td>No</td>
<td>24/163 (14.7%)</td>
<td>8/83 (9.6%)</td>
<td>-5.1%</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>16/38 (42.1%)</td>
<td>4/18 (28.6%)</td>
<td>-13.5%</td>
</tr>
<tr>
<td>Linear FB</td>
<td>No</td>
<td>20/141 (14.2%)</td>
<td>5/75 (6.7%)</td>
<td>-7.5%</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>20/60 (33.3%)</td>
<td>7/26 (26.9%)</td>
<td>-6.4%</td>
</tr>
<tr>
<td>Solitary FB</td>
<td>No</td>
<td>24/96 (25%)</td>
<td>7/26 (26.9%)</td>
<td>1.9%</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>16/105 (15.2%)</td>
<td>5/75 (6.7%)</td>
<td>-8.5%</td>
</tr>
<tr>
<td>Enterotomy</td>
<td>No</td>
<td>31/121 (25.6%)</td>
<td>8/49 (16.3%)</td>
<td>-9.3%</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>9/80 (11.3%)</td>
<td>4/52 (8.3%)</td>
<td>-3%</td>
</tr>
<tr>
<td>Known self-trauma</td>
<td>No</td>
<td>33/183 (18%)</td>
<td>10/99 (10.1%)</td>
<td>-7.9%</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>3/4 (75%)</td>
<td>2/2 (100%)</td>
<td>25%</td>
</tr>
</tbody>
</table>

**References**

Current trends in the management of canine traumatic brain injury: An Internet-based survey

Emma Kathryn Evans, Alberto L. Fernandez

Abstract – This study characterized trends in management of canine traumatic brain injury (TBI) among 182 small animal veterinarians grouped as follows: Board-certified specialists at a veterinary teaching hospital (BCS-VTH), Board-certified specialists in private practice (BCS-PP), non-specialists at a teaching hospital (DVM-VTH), and non-specialists in private practice (DVM-PP). The BCS-VTH, BSC-PP, and DVM-VTH groups were more comfortable using the modified Glasgow Coma Scale (MGCS) than the DVM-PP group (P < 0.001, P < 0.001, and P = 0.009, respectively). All respondents chose the following diagnostics most frequently: packed cell volume/total solids (95.6%), blood glucose (96.7%), and blood pressure (95.0%). The DVM-VTH group chose the following more frequently than the DVM-PP group: computed tomography (19.4% versus 4.5%; P = 0.027), venous or arterial blood gas (83.9% versus 46.3%; P < 0.001), electrocardiography (71.0% versus 44.8%; P = 0.018), lactate (87.1% versus 59.7%; P = 0.009), and brief thoracic ultrasound (87.1% versus 62.7%; P = 0.017). BCS-PP chose hypertonic saline more frequently than DVM-PP (94.1% versus 74.6%; P = 0.005). The DVM-PP group chose corticosteroid therapy and anticonvulsant therapy more frequently than BCS-PP (10.4% versus 0.0%; P = 0.019; 73.1% versus 43.1%; P = 0.004, respectively). This study highlights variability in management of canine TBI.

Résumé – Tendances actuelles dans la gestion des traumatismes cérébraux canins : sondage sur Internet.
Cette étude a caractérisé les tendances dans la gestion des traumatismes cérébraux canins (TC) parmi 182 médecins vétérinaires pour petits animaux regroupés de la façon suivante : spécialistes agréés par un conseil dans un hôpital d’enseignement vétérinaire (BCS-VTH), spécialistes agréés en pratique privée (BCS-PP), non-spécialistes dans un hôpital d’enseignement vétérinaire (DVM-VTH) et non-spécialistes en pratique privée (DVM-PP). Les BCS-VTH, les BSC-PP et les DVM-VTH étaient plus à l’aise lors de l’utilisation de l’échelle de Glasgow modifiée (MGCS) que les DVM-PP (P < 0.001, P < 0.001 et P = 0.009, respectivement). Tous les répondants ont choisi les diagnostics suivants le plus fréquemment : valeur d’hématocrite/solides totaux (95.6 %), glycémie (96.7 %) et tension artérielle (95.0 %). Le groupe DVM-VTH a choisi les éléments suivants plus fréquemment que le groupe DVM-PP : tomodensitométrie (19.4 % contre 4.5 %; P = 0.027), gaz du sang veineux ou artériel (83.9 % contre 46.3 %; P < 0.001), électrocardiographie (71.0 % contre 44.8 %; P = 0.018), lactate (87.1 % contre 59.7 %; P = 0.009) et une brève échographie thoracique (87.1 % contre 62.7 %; P = 0.017). Le groupe BCS-PP a choisi la solution saline hypertonique plus fréquemment que le groupe DVM-PP (94.1 % contre 74.6 %; P = 0.005). Le groupe DVM-PP a choisi la thérapie corticostéroïde et une thérapie anti-convulsivante plus fréquemment que le groupe BCS-PP (10.4 % contre 0.0 %; P = 0.019; 73.1 % contre 43.1 %; P = 0.004, respectivement). Cette étude souligne la variabilité dans la gestion des TC canins.

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Introduction

Canine traumatic brain injury (TBI) presents a therapeutic challenge to the veterinary practitioner. Moderate to severe TBI requires prompt recognition and therapeutic intervention to prevent rapid neurologic deterioration or death. Recommendations for the optimal management of human TBI patients are evolving and consensus guidelines for the management of canine TBI patients are lacking. Review articles describing the pathophysiology of canine TBI (1) and summarizing current recommendations for the management of small animal neurologic trauma (2) underscore the complexity of brain injury. As the pathophysiology is better elucidated, an increasing number of diagnostic and therapeutic targets have been identified. The utility of these diagnostics and the efficacy of specific therapies remain controversial, however. For example, veterinary studies that have evaluated the prognostic utility of advanced imaging [magnetic resonance imaging (MRI)] in canine head trauma suggest that there are significant associations between intraparenchymal lesions and prognosis (3). However, the cost, anesthetic risks, and availability of advanced imaging must be measured against its prognostic value. Further, both traditional and novel treatments for TBI continue to be debated and investigated. The human literature provides conflicting results regarding the superiority of hypertonic saline or mannitol for the treatment of intracranial hypertension, for example (4). Moreover, while human and canine head trauma patients appear to be at increased risk for post-traumatic seizures (5,6), the benefit of implementing prophylactic anticonvulsant therapy is unclear (2).

This Internet survey-based study was conducted as a preliminary step towards a larger goal: to initiate the development of formal and more widely available treatment guidelines for canine TBI. Surveys of current clinical practice can provide the foundation for the development of consensus guidelines for case management. In addition to identifying areas of clinical equipoise for further investigation, a thorough understanding of current clinical practice is necessary to identify barriers to implementation of guidelines and is a prerequisite for any study of the improvement of quality of care (7). The primary objective of this study was to characterize the current diagnostic and therapeutic strategies employed in the management of canine traumatic brain injury (TBI). The authors speculated that diagnostic and therapeutic preferences would be heterogeneous among practitioners surveyed.

Materials and methods

An Internet-based survey was used to interview practicing veterinarians regarding their management of canine TBI. The survey was conducted over a 3-month period (June to August 2016). The survey was constructed with the assistance of an Internet-based continuing education platform (VETgirl: Veterinary Continuing Educations Podcasts and Webinars) and distributed through social media as well as by e-mail. E-mail invitations were sent to veterinary professional list server groups [American College of Veterinary Emergency and Critical Care (ACVECC) and American College of Veterinary Internal Medicine (ACVIM) discussion list servers]. There was a total of 182 veterinarian respondents. The survey required that all questions be completed before submission, precluding the inclusion of incomplete surveys in data analysis. Responses from veterinary students and veterinary technicians were not included in final data analysis.

Survey characteristics

The survey contained 24 questions on diagnostic and therapeutic preferences in canine TBI cases. The questions were a combination of multiple-choice questions that permitted a single response, multiple choice questions that allowed for multiple responses, and a small number of open-ended questions. The questionnaire is available on request from the corresponding author. Respondents were divided into 4 categories: Board-certified specialists at a veterinary teaching hospital (BCS-VTH), Board-certified specialists in private practice (BCS-PP), non-specialists affiliated with a teaching hospital (DVM-VTH), and non-specialists in private practice (DVM-PP). The Board-certified specialists were individuals with diplomate status in American College of Emergency and Critical Care, American College of Veterinary Internal Medicine, American College of Veterinary Surgeons, or American College of Veterinary Anesthesia and Analgesia.

Statistical analysis

The survey questions were analyzed as a multinomial random variable when the survey question allowed the respondent to only choose a single response from a list. When respondents could choose multiple responses from a list, the data were analyzed per response category as a binomial random variable. Under the multinomial response paradigm, the multinomial relative frequency distributions of the BCS-VTH, the BCS-PP, the DVM-VTH, and the DVM-PP were compared by the conventional likelihood Chi-squared test when all of the multinomial categories were non-sparingly populated, and by the Pearson Chi-squared exact test when 1 or more of the multinomial cell frequency categories was sparsely populated. Under the binomial response paradigm, the binomial relative frequency distributions of the BCS-VTH, BCS-PP, DVM-VTH, and DVM-PP were compared by the conventional Fishers exact test. For hypothesis testing, a $P \leq 0.05$ decision rule was used as the null hypothesis rejection criterion for all between-group comparisons. A commercial statistical analysis program (SAS version 9.4; SAS Institute, Cary, North Carolina, USA) was used to conduct all statistical analyses.

Results

Respondent characteristics

A total of 182 respondents was included in the analysis. Respondents were placed in 1 of 4 categories for analysis: BCS-VTH: 33 respondents; DVM-VTH: 31 respondents; BCS-PP: 51 respondents); and DVM-PP: 67 respondents. The most frequent workplace categories cited were private practice specialty hospital (39.0%), private practice emergency practice (31.9%), and veterinary teaching hospital (35.2%). All respondents selected small animal as at least part of their patient population.
Table 1. Responses to the survey question: What is your comfort level using the modified Glasgow Coma Scale (MGCS)?

<table>
<thead>
<tr>
<th>Group</th>
<th>Not comfortable</th>
<th>Moderately comfortable</th>
<th>Very comfortable</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCS-VTH</td>
<td>9.1</td>
<td>33.3</td>
<td>57.6</td>
</tr>
<tr>
<td>BCS-PP</td>
<td>9.8</td>
<td>39.2</td>
<td>51.0</td>
</tr>
<tr>
<td>DVM-VTH</td>
<td>22.6</td>
<td>32.2</td>
<td>45.2</td>
</tr>
<tr>
<td>DVM-PP</td>
<td>40.3</td>
<td>32.2</td>
<td>17.9</td>
</tr>
</tbody>
</table>

Table 2. Responses to the survey question: What initial diagnostics do you perform (within 4 hours of admission) on a canine traumatic brain injury patient?

<table>
<thead>
<tr>
<th>Diagnostic test</th>
<th>BCS-VTH</th>
<th>BCS-PP</th>
<th>DVM-VTH</th>
<th>DVM-PP</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCV/TS</td>
<td>100</td>
<td>98.0</td>
<td>100</td>
<td>89.6</td>
</tr>
<tr>
<td>Blood glucose</td>
<td>100</td>
<td>98.0</td>
<td>93.5</td>
<td>95.5</td>
</tr>
<tr>
<td>Lactate</td>
<td>93.9</td>
<td>68.6</td>
<td>87.1</td>
<td>59.7</td>
</tr>
<tr>
<td>CBC</td>
<td>48.5</td>
<td>74.5</td>
<td>45.2</td>
<td>70.1</td>
</tr>
<tr>
<td>Serum chemistry</td>
<td>45.5</td>
<td>78.4</td>
<td>41.9</td>
<td>76.1</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>97.0</td>
<td>100</td>
<td>93.5</td>
<td>91.0</td>
</tr>
<tr>
<td>Cerebrospinal fluid testing</td>
<td>9.1</td>
<td>2.0</td>
<td>25.8</td>
<td>20.9</td>
</tr>
<tr>
<td>Pulse oximetry</td>
<td>81.8</td>
<td>80.4</td>
<td>67.7</td>
<td>73.1</td>
</tr>
<tr>
<td>ECG</td>
<td>75.8</td>
<td>41.2</td>
<td>71.0</td>
<td>44.8</td>
</tr>
<tr>
<td>Survey radiographs</td>
<td>33.3</td>
<td>70.6</td>
<td>35.5</td>
<td>71.6</td>
</tr>
<tr>
<td>Brief abdominal ultrasound</td>
<td>97.0</td>
<td>84.3</td>
<td>87.1</td>
<td>71.6</td>
</tr>
<tr>
<td>Brief thoracic ultrasound</td>
<td>81.8</td>
<td>58.8</td>
<td>87.1</td>
<td>62.7</td>
</tr>
<tr>
<td>CT</td>
<td>18.2</td>
<td>3.9</td>
<td>19.4</td>
<td>4.5</td>
</tr>
<tr>
<td>MRI</td>
<td>0</td>
<td>3.2</td>
<td>3.2</td>
<td>1.5</td>
</tr>
<tr>
<td>EEG</td>
<td>0</td>
<td>3.2</td>
<td>3.2</td>
<td>1.5</td>
</tr>
<tr>
<td>Measurement of intracranial pressure</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3.0</td>
</tr>
<tr>
<td>Venous or arterial blood gas</td>
<td>81.8</td>
<td>60.8</td>
<td>83.9</td>
<td>46.3</td>
</tr>
<tr>
<td>Other</td>
<td>15.2</td>
<td>2.0</td>
<td>9.7</td>
<td>3.0</td>
</tr>
</tbody>
</table>

BCS-VTH — Board-certified veterinarians working at a veterinary teaching hospital; BCS-PP — Board-certified veterinarians working in private practice; DVM-VTH — non-Board-certified veterinarians working at a veterinary teaching hospital; DVM-PP — non-Board-certified veterinarians working in private practice.

Incidence of canine TBI and preliminary clinical criteria used to further evaluate canine TBI cases

All respondents most frequently indicated that they saw or treated 1 to 5 cases of canine TBI per month (including poly-trauma cases suspected to have TBI). The clinical criteria most often selected to further evaluate canine TBI cases included changes in mentation/responsiveness (98.4%), changes in pupil size, symmetry, responsiveness, or other cranial nerve deficits (97.8%), and hypertension/bradycardia (92.9%). Additional criteria, including evidence of external trauma (88.5%), evidence of seizures (86.8%), and changes in posture or ability to ambulate (82.4%), were also frequently chosen. Overall, 73.6% of respondents identified the modified Glasgow Coma Scale (MGCS) as part of the clinical criteria. The BCS-VTH practitioners were more likely to include the MGCS as part of their clinical criteria than were DVM-PP practitioners (P = 0.013). Similarly, BCS-PP practitioners were more likely to include the MGCS than were DVM-PP practitioners (P = 0.004).

Modified Glasgow Coma Scale: Utility of the MGSC and comfort level using the MGCC

Most practitioners indicated that the MGCS was moderately useful (62.6% of respondents). The majority of respondents were either moderately comfortable (37.9%) or very comfortable (39.0%) using the MGCS (Table 1). The DVM-VTH practitioners were more comfortable using the MGCS than were DVM-PP practitioners (P = 0.009). The BCS-VTH and BCS-PP practitioners also indicated they were more comfortable using the MGCS than were DVM-PP practitioners (both P < 0.001).

When asked about the frequency with which the MGCS is used in canine TBI patients, 48.4% of DVM-VTH practitioners responded that they used the MGCS in all patients while 23.9% of DVM-PP practitioners responded that they used the MGCS in all patients (P = 0.020). The DVM-PP practitioners were more likely to never use the MGCS (23.9%) compared with the BCS-PP practitioners (5.9%; P = 0.011). There were no significant differences among the responses of Board-certified specialist groups (P > 0.05).

Among all groups, 34.6% of survey respondents indicated that they repeat the MGCS in fewer than 50% of cases. Additional responses were as follows: the MGCS is never repeated at regular intervals (22.0%), the MGCS is repeated at regular intervals in > 50% but not all patients (22.5%), and the MGCS is repeated at regular intervals in all TBI patients (20.9%).

Initial diagnostic testing performed in canine TBI cases

The diagnostic tests most frequently performed on a TBI patient within the first 4 h of admission by all respondents included packed cell volume/total solids (PCV/TS) (95.6%), blood glucose (96.7%), and blood pressure (95.0%) (Table 2). Practitioners at a teaching hospital (BCS-VTH and DVM-VTH) indicated that they use lactate (93.9% versus 68.6%; P = 0.005), electrocardiogram (ECG) (75.8% versus 41.2%; P = 0.003), and brief thoracic ultrasound (81.8% versus 58.8%; P = 0.032) more frequently than did their private practice counterparts (BCS-PP and DVM-PP). When DVM-VTH and DVM-PP groups were compared, DVM-VTH practitioners chose computed tomography (CT) (19.4% versus 4.5%; P = 0.027), venous or arterial blood gas (83.9% versus 46.3%; P < 0.001), ECG (71.0% versus 44.8%; P = 0.018), lactate (87.1% versus 59.7%; P = 0.009), and brief thoracic ultrasound (87.1% versus 62.7%; P = 0.017) more frequently than did their private practice counterparts. Conversely, DVM-PP practitioners more frequently chose complete blood (cell) count (CBC) (70.1% versus 45.2%; P = 0.025), serum chemistry (76.1% versus 41.9%; P = 0.001), and survey radiographs (71.6% versus 35.5%; P = 0.001) as part of their initial diagnostic plan than did DVM-VTH practitioners.
Table 3. Responses to the survey question: What initial therapeutics do you consider in canine traumatic brain injury cases?

<table>
<thead>
<tr>
<th>Therapeutic</th>
<th>Percent (%) of responses within each group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BCS-VTH</td>
</tr>
<tr>
<td>Mannitol</td>
<td>84.8</td>
</tr>
<tr>
<td>Hypertonic saline</td>
<td>87.9</td>
</tr>
<tr>
<td>Crystalloid fluid therapy</td>
<td>84.8</td>
</tr>
<tr>
<td>Colloid fluid therapy</td>
<td>27.3</td>
</tr>
<tr>
<td>Elevation of head (inclined board)</td>
<td>97.0</td>
</tr>
<tr>
<td>Oxygen therapy</td>
<td>93.9</td>
</tr>
<tr>
<td>Corticosteroid therapy</td>
<td>3.0</td>
</tr>
<tr>
<td>Non-steroidal anti-inflammatory therapy</td>
<td>0</td>
</tr>
<tr>
<td>Opoid therapy</td>
<td>87.9</td>
</tr>
<tr>
<td>Anticonvulsant therapy</td>
<td>54.5</td>
</tr>
<tr>
<td>Therapeutic hypothermia</td>
<td>18.2</td>
</tr>
<tr>
<td>Mechanical ventilation</td>
<td>45.5</td>
</tr>
<tr>
<td>Hyperventilation</td>
<td>9.1</td>
</tr>
<tr>
<td>Antibiotic therapy</td>
<td>18.2</td>
</tr>
<tr>
<td>Insulin therapy</td>
<td>0</td>
</tr>
<tr>
<td>Antioxidant/ Free-radical scavenging therapy</td>
<td>9.1</td>
</tr>
</tbody>
</table>

BCS-VTH — Board-certified veterinarians working at a veterinary teaching hospital; BCS-PP — Board-certified veterinarians working in private practice; DVM-VTH — non-Board-certified veterinarians working at a veterinary teaching hospital; DVM-PP — non-Board-certified veterinarians working in private practice.

Initial therapeutic interventions used in canine TBI cases

The initial therapeutic interventions chosen for TBI are summarized in Table 3. The most frequently selected treatments among all respondents included mannitol (89.0%), hypertonic saline (85.1%), crystalloid fluids (91.2%), elevation of the head (93.4%), oxygen therapy (93.4%), and opioid analgesia (84.6%).

The BCS-PP practitioners were more likely to choose hypertonic saline than were the DVM-PP practitioners; 94.1% BCS-PP practitioners chose hypertonic saline compared with 74.6% DVM-PP practitioners (P = 0.005). While 10.4% of DVM-PP practitioners chose corticosteroids as part of their initial treatment plan, none of the BCS-PP clinicians selected corticosteroid therapy (P = 0.019). Moreover, 73.1% DVM-PP clinicians chose anticonvulsant therapy compared to 47.1% of BCS-PP practitioners (P = 0.004).

Treatment(s) of choice for intracranial hypertension

Hypersomolar agents were the initial therapy of choice for intracranial hypertension (ICH). Mannitol was chosen by 73.0% of participants and hypertonic saline was chosen by 73.6% of participants. Corticosteroid therapy (0.03%), colloid therapy (0.05%), and decompressive craniectomy (0.02%) were chosen much less frequently (Table 4). According to most respondents, mannitol and hypertonic saline were both available for use at all times (90.7%).

Patient factors appeared to influence the choice of first-line therapy for ICH more so than specific characteristics of hypertonic saline versus mannitol. The patient's volume status and/or hemodynamic stability appeared to influence initial therapeutic choices most often (82.4%). Comorbidities were also frequently considered when choosing a therapy (75.8%). DVM-VTH practitioners were more likely to indicate that “results of advanced imaging” guided first-line therapy for ICH than did their DVM-PP counterparts (16.1% versus 1.5%; P = 0.012).

The physical properties of mannitol and hypertonic saline as hypersomolar agents, their effects on inflammation, and their ability to modulate oxidative injury were chosen with a similar frequency (33.5%, 27.4%, and 26.9% of all respondents, respectively). The rheological effects of hypertonic saline and mannitol were considered by 25.2% of all respondents.

Improved mentation or responsiveness was the most important clinical criterion used to guide treatment for TBI, chosen with a frequency of 99.4%. The following clinical criteria were also frequently considered: resolution of the hemodynamic changes associated with intracranial hypertension (90.6%) and improvement of pupil size, symmetry, and reactivity (93.4%). Control of clinical seizures was chosen by 76.3% of respondents, while improvement of the MGCS score was chosen by 64.2% of all respondents. Improvement of ventilation parameters, normolactatemia, and normoglycemia were chosen by 47.8%, 42.3%, and 41.7%, respectively. Achieving a normal EEG was rarely chosen to guide continued therapy (0.04% of all respondents; Table 5).

Pathophysiology of secondary brain injury

Most practitioners were either very familiar (42.3%) or somewhat familiar (43.4%) with the pathophysiology of secondary brain injury. Board-certified specialists were more likely to be very familiar with secondary brain injury than non-Board-certified specialists of either group: 63.6% BCS-VTH practitioners and 66.7% BCS-PP practitioners indicated they were very familiar with secondary brain injury, whereas 38.7% DVM-VTH practitioners and 14.9% DVM-PP practitioners indicated that they were very familiar with secondary brain injury. The DVM-VTH practitioners were more likely to indicate that they were very familiar with secondary brain injury than were the DVM-PP practitioners (DVM-VTH 38.7% versus DVM-PP 14.9%; P = 0.017).

Availability and accessibility of canine TBI treatment guidelines and comfort level treating canine TBI

According to most respondents, guidelines for canine TBI are somewhat clear (68.1%) and moderately available and accessible (67.6%). Among all groups, 54.4% of respondents felt very comfortable treating TBI. A substantial number of respondents indicated they were moderately comfortable (40.7%), and a lesser number indicated they were not comfortable treating TBI (4.9%). Board-certified specialists of both groups were
Table 4. Responses to the survey question: What is your first-line therapy of choice for intracranial hypertension?

<table>
<thead>
<tr>
<th>Group</th>
<th>Mannitol</th>
<th>Hypertonic saline</th>
<th>Colloid</th>
<th>Corticosteroids</th>
<th>Decompressive craniectomy</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCS-VTH</td>
<td>57.6</td>
<td>84.8</td>
<td>3.0</td>
<td>0</td>
<td>3.0</td>
<td>0</td>
</tr>
<tr>
<td>BCS-PP</td>
<td>68.6</td>
<td>72.5</td>
<td>3.9</td>
<td>0</td>
<td>2.0</td>
<td>3.9</td>
</tr>
<tr>
<td>DVM-VTH</td>
<td>93.5</td>
<td>87.1</td>
<td>3.2</td>
<td>6.5</td>
<td>6.5</td>
<td>3.2</td>
</tr>
<tr>
<td>DVM-PP</td>
<td>74.6</td>
<td>62.7</td>
<td>7.5</td>
<td>6.0</td>
<td>0</td>
<td>6.0</td>
</tr>
</tbody>
</table>

BCS-VTH — Board-certified veterinarians working at a veterinary teaching hospital; BCS-PP — Board-certified veterinarians working in private practice; DVM-VTH — non-Board-certified veterinarians working at a veterinary teaching hospital; DVM-PP — non-Board-certified veterinarians working in private practice.

Table 5. Responses to the survey question: What clinical criteria do you use to guide therapy in canine traumatic brain injury?

<table>
<thead>
<tr>
<th>Clinical criterion</th>
<th>Percent (%) of responses within each group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved mentation/responsiveness</td>
<td>BCS-VTH: 97.0 BCS-PP: 100 DVM-VTH: 100 DVM-PP: 100</td>
</tr>
<tr>
<td>Improved MGCS score</td>
<td>75.8 BCS-VTH: 72.5 DVM-VTH: 61.3 DVM-PP: 53.7</td>
</tr>
<tr>
<td>Normotension and normal heart rate</td>
<td>87.9 BCS-VTH: 92.2 DVM-VTH: 90.3 DVM-PP: 91.0</td>
</tr>
<tr>
<td>Normal pupil size, symmetry, and reactivity</td>
<td>78.8 BCS-VTH: 96.1 DVM-VTH: 93.5 DVM-PP: 98.5</td>
</tr>
<tr>
<td>Eupnea</td>
<td>72.7 BCS-VTH: 80.4 DVM-VTH: 67.7 DVM-PP: 80.6</td>
</tr>
<tr>
<td>Normocapnia</td>
<td>69.7 BCS-VTH: 37.3 DVM-VTH: 54.8 DVM-PP: 41.6</td>
</tr>
<tr>
<td>Normoglycemia</td>
<td>51.5 BCS-VTH: 39.2 DVM-VTH: 32.3 DVM-PP: 43.3</td>
</tr>
<tr>
<td>Normolactatemia</td>
<td>57.6 BCS-VTH: 35.3 DVM-VTH: 51.6 DVM-PP: 35.8</td>
</tr>
<tr>
<td>Control of clinical seizures</td>
<td>72.7 BCS-VTH: 70.6 DVM-VTH: 71.0 DVM-PP: 85.1</td>
</tr>
<tr>
<td>Normal EEG</td>
<td>0 BCS-VTH: 2.0 DVM-VTH: 3.2 DVM-PP: 7.5</td>
</tr>
<tr>
<td>Other</td>
<td>3.0 BCS-VTH: 2.0 DVM-VTH: 0 DVM-PP: 1.5</td>
</tr>
</tbody>
</table>

BCS-VTH — Board-certified veterinarians working at a veterinary teaching hospital; BCS-PP — Board-certified veterinarians working in private practice; DVM-VTH — non-Board-certified veterinarians working at a veterinary teaching hospital; DVM-PP — non-Board-certified veterinarians working in private practice.

Discussion

This survey identified some conserved practices implemented by most practitioners, as well as specific differences in diagnostic and therapeutic approaches to canine TBI. While all respondents appear to rely heavily on the results of a complete neurologic examination, Board-certified specialists were more comfortable with the use of the MGCS and used it more frequently than did other groups. The explanations for these discrepancies were not addressed in this survey. A future survey could be constructed to more specifically interrogate clinicians about their familiarity with and exposure to the MGCS at varying levels of education and training. The Glasgow Coma Scale (GCS) has traditionally been considered the gold standard in human medicine for providing an objective neurologic assessment of the level of consciousness in human patients with severe brain injury (8). Initial as well as serial GCS scores can be used to guide therapy, compare treatment efficacies, and determine prognosis in human patients sustaining brain injury (8–10). Similar to the GCS in human comatose patients, the MGCS serves as an objective neurologic assessment that can be performed at the time of admission and repeated at intervals during hospitalization. Previous veterinary studies that have evaluated prognostic indicators in head trauma have found the MGCS to be a useful indicator of survival in the TBI patient population (11–14). Given its prognostic utility, concerted efforts to teach and to reinforce consistent use of the MGCS in canine TBI cases seem warranted.

Initial diagnostic tests performed in TBI cases help to guide therapeutic interventions and to provide prognostic information. Based on retrospective veterinary studies, neither blood pressure nor blood glucose at the time of admission is predictive of outcome in TBI, although hyperglycemia may indicate the severity of brain injury (12). While hyperglycemia has been associated with poor outcome in humans with TBI in clinical studies, some studies suggest that episodic hyperglycemia may improve cerebral metabolism and mitigate secondary brain injury (15). The effects of glucose control on neurologic outcome or survival in canine TBI patients have yet to be determined. Moreover, indicators of hypoperfusion or metabolic dysfunction, including increased lactate, decreased blood pH, increased base deficit, and decreased bicarbonate, have been shown to be predictive of non-survival in dogs with traumatic brain injury (12). The non-uniform pattern of diagnostic tests chosen by practitioners at a teaching hospital versus those in private practice in this survey suggests a lack of clarity regarding the utility — or necessity — of specific diagnostics. The disparity seen in responses should prompt the construction of a more formal diagnostic algorithm that can be applied to canine TBI cases.

Neuroimaging in the acute canine TBI patient was infrequently chosen as a diagnostic tool among all respondents in this survey. Neuroimaging allows for the identification of structural changes to brain and skull and may be used to guide therapy in the head trauma patient. In humans, CT remains the imaging modality of choice for head trauma within the first 24 h of injury, as it allows for rapid assessment for hemorrhage and fractures (16). As the sequelae of secondary brain
Injury develop, however, MRI becomes the superior imaging modality for detecting changes to the brain parenchyma and becomes the imaging modality of choice 24 h or more after the injury (16,17). A study evaluating MRI in dogs with head trauma demonstrated associations between MRI findings and prognosis (3). In veterinary patients, however, CT and MRI often require heavy sedation or anesthesia to obtain images of diagnostic quality, so in addition to cost, the risks and benefits of advanced imaging to the individual patient must be carefully considered (14). A follow-up survey could be designed to identify the reasons that clinicians infrequently pursue advanced imaging in the context of canine TBI (i.e., perceived value or necessity of information obtained, financial costs, anesthetic risks, accessibility, other reasons). Specific recommendations regarding neuroimaging in the canine TBI patient and the optimum time at which to perform imaging would be of value in the construction of treatment guidelines.

Therapeutic options for canine TBI are numerous and often controversial. Corticosteroid therapy was chosen by fewer than 5% of respondents; however, 10.4% of non-specialists in private practice indicated that they use corticosteroids in the management of TBI. A randomized control trial evaluating corticosteroid administration in human head trauma (CRASH study) found no clinical benefit to corticosteroid therapy and in fact showed increased early mortality rates in patients who received corticosteroids (18). Prior to this study, corticosteroids were more commonly used in the treatment of TBI. Although there are no studies that evaluate the use of corticosteroids in canine TBI, given the evidence for harm in the human population, the authors believe it is prudent to recommend against the use of corticosteroids in the treatment of TBI.

Anticonvulsant therapy was chosen by approximately 50% of respondents, which suggests a lack of consensus regarding the necessity of seizure prophylaxis. In humans, seizure prophylaxis is recommended in severe TBI patients (5,19,20). Studies evaluating EEG findings in human patients with moderate to severe TBI have shown that post-traumatic seizures occur in approximately 20% of the patient population; most of these seizures are non-convulsive and detected on EEG alone (19). Similarly, a study evaluating the incidence of post-traumatic seizures in dogs with head trauma revealed a greater incidence of seizures in trauma patients than in the general population (6). While prompt treatment of overt seizure activity in canine TBI patients is unlikely to be contested, the necessity for seizure prophylaxis remains controversial (1). Further, the anticonvulsant of choice for seizure prophylaxis, as well as the diagnostic modalities necessary to detect non-convulsive seizures, warrant further investigation before specific recommendations can be made.

While hyperosmolar agents have antioxidant properties, the addition of other antioxidants for the explicit purpose of scavenging reactive oxygen species was infrequently chosen as an initial therapeutic intervention for TBI. Studies evaluating the effect of specific antioxidants on outcome in human and veterinary TBI cases are lacking. It has been postulated that the mitigation of oxidative stress may be an important therapeutic target in TBI (21,22).

Intracranial hypertension is a severe complication of TBI and exacerbates cerebral ischemia and secondary brain injury (1,23). While surgical decompression via craniectomy may provide an acute reduction in intracranial pressure, intracranial hypertension is much more commonly treated with hyperosmolar therapies that target the reduction of interstitial edema within the brain (1,23). Mannitol and hypertonic saline are the 2 most widely used hyperosmolar agents in both human and veterinary medicine (1,4,23,24). In this survey, respondents chose mannitol and hypertonic saline as their first-line treatment of choice for intracranial hypertension with very similar frequencies. Beyond their hyperosmolar properties, the 2 therapies have varying effects on rheology, cerebral vasospasm, cardiac output, intravascular volume, and inflammation (4,24,25). Individual studies and meta-analyses in human medicine have sought to compare mannitol to hypertonic saline to determine whether there is a superior hyperosmolar therapy for the management of intracranial hypertension (4,26). While some studies suggest that hypertonic saline may more effectively reduce intracranial pressure compared with mannitol (1,4,26,27), these studies do not demonstrate that hypertonic saline improves survival or neurological signs relative to mannitol (27). Current guidelines for the treatment of severe TBI in humans do not recommend one hyperosmolar solution over the other, citing that there is insufficient evidence to do so (28). The relative benefits of hypertonic saline versus mannitol have not been investigated in naturally occurring TBI in the dog.

This study has several limitations. While the survey was distributed across 2 list servers and a veterinary continuing education social media platform for a 3-month period, the total number of respondents was small. The sample size was sufficient for the identification of statistically significant differences between groups; however, a larger number of participants would have increased the power to detect smaller differences. Furthermore, there was a limited number of questions that required clinicians to make diagnostic or therapeutic choices without case-specific information. As with any survey-based study, the construction of the questionnaire may have influenced survey results.

In conclusion, the results of this study suggest that significant heterogeneity exists in the assessment and treatment of canine TBI in the veterinary community. In particular, there is variation in the use of the MGCS, monitoring of oxygenation, ventilation and perfusion, and treatment with corticosteroids and hyperosmolar therapies, despite existing evidence for or against these interventions. This study highlights the need for evidence-based consensus guidelines for the treatment of TBI and identifies clinically relevant gaps in understanding that warrant further research.

Acknowledgments

The authors thank James Patrie for performing the statistical analyses, Cape Cod Veterinary Specialists for their financial support of the project, Dr. Louisa Rahilly for critical review of the survey, Dr. Shana O’Marra for critical review of the manuscript, and Dr. Justine Lee with VETgirl: Veterinary Continuing Education Podcasts and Webinars for critical review of the survey and assistance with survey distribution. The authors also thank those who responded to the survey questions.
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Dr. Todd Duffield named as the 2018 Metacam® 20 Bovine Welfare Award winner

Dr. Todd Duffield of Guelph, Ontario has been named the recipient of the 2018 Metacam® 20 Bovine Welfare Award for his profound and lasting impact on the well-being of the bovine species. His contributions include an extraordinary commitment to scientific research, teaching, extension education and the mentorship of veterinary students and new scientists.

The award is presented annually by the Canadian Association of Bovine Veterinarians (CABV)/Association Canadienne des Vétérinaires Bovins (ACVB) in partnership with Boehringer Ingelheim Animal Health. Dr. Duffield was presented with the award at the 51st annual conference of the American Association of Bovine Practitioners on September 13, 2018 in Phoenix, Arizona.

Dr. Duffield is the Chair of the Department of Population Medicine at the University of Guelph’s Ontario Veterinary College (OVC). He has been a faculty member at the university since 2000 and has continued as a practicing clinician, working at OVC’s Ruminant Field Service Veterinary Practice, where he also served as Clinic Head and Service Chief.

Dr. Duffield is a world-class research scientist and has authored or co-authored more than 160 articles in peer-reviewed journals. He was named as one of the World’s Most Influential Scientific Minds by Thomas Reuters as a highly-cited researcher.

“I am extremely pleased and honoured to receive the 2018 Metacam® 20 Bovine Welfare award,” said Dr. Duffield. “It takes a team effort to advance knowledge and understanding through research and our work with dairy cattle welfare is no exception. I am very grateful for the excellent work of my outstanding graduate students and for the sage guidance of my mentors, colleagues and collaborators over my years at OVC. Sincere thanks to the Canadian Association of Bovine Veterinarians for recognizing me with this prestigious award.”

Recognized for his many contributions to the advancement in animal welfare, Dr. Duffield receives high praise from his peers.

“Todd has spent two and a half decades enhancing our knowledge of dairy cattle well-being across a wide variety of impact areas; from metabolic disease control, to prevention of lameness, to pain mitigation, and recently to the selection and preparation of cows to be culled to prevent animal welfare concerns,” said Dr. Ken Leslie, Professor Emeritus, Department of Population Medicine, University of Guelph. “His research in the area of ketosis in dairy cattle has transformed our understanding and management of this major problem and has directly affected the health of millions of cattle globally.”

In addition to his contributions to scientific research, Dr. Duffield is also commended for his commitment to ensuring the next generations of veterinarians and scientists are knowledgeable and skilled in the areas of food animal medicine and animal welfare.

“Among the reasons Todd has been so effective in identifying and implementing bovine welfare solutions is the fact that he plants one boot in academia, but keeps the other boot firmly planted on the farm,” said Dr. Suzanne Millman, Professor, Animal Welfare, College of Veterinary Medicine, Iowa State University. “Through his dedication, he shares his knowledge and skills in bovine welfare to producers, senior veterinary students and graduate students.”

Jeffrey Estabrooks, Business Unit Director (Bovine) with Boehringer Ingelheim Animal Health, explained the Metacam® 20 Bovine Welfare Award recognizes and encourages those who research and practice animal welfare and well-being.

“We are thrilled to present Dr. Duffield with the 2018 Metacam® 20 Bovine Welfare Award,” Estabrooks said. “Through his passion for advancing animal welfare, Dr. Duffield has made significant contributions to the improvement of dairy cattle welfare within Canada and around the world. As a well-respected veterinarian, researcher and educator, he has been able to instill his passion for the advancement of animal welfare in future generations of veterinarians and scientists.”

Estabrooks thanked the CABV/ACVB for its work to seek nominations and select the recipient of the award.

Contact: Canadian Association of Bovine Veterinarians (CABV)/Association Canadienne des Vétérinaires Bovins (ACVB), 226E Wheeler Street, Saskatoon, SK S7P 0A9; phone: (306) 956-3543; e-mail: cabv.acvb@sasktel.net; website: www.cabv.ca
A review of Horner’s syndrome in small animals

Danielle M. Zwueste, Bruce H. Grahn

Abstract — Horner’s syndrome arises from dysfunction of the oculosympathetic pathway and is characterized by miosis, enophthalmos, protrusion of the third eyelid, and ptosis. It has been recognized in a wide variety of breeds and ages in small animal patients. The oculosympathetic pathway is a 3-neuron pathway. The central/first order neuron arises from the hypothalamus and extends down the spinal cord. The preganglionic/second order neuron arises from the first 3 thoracic spinal cord segments and travels through the thorax and cervical region until it synapses at the cranial cervical ganglion. The postganglionic/third order neuron travels from this ganglion to the orbit. Topical application of cocaine is the gold standard for differentiating Horner’s syndrome from other causes of miosis. Topical 1% phenylephrine allows for identification of a post-ganglion Horner’s syndrome. Numerous etiologies have been reported for Horner’s syndrome, but idiopathic disease is most common. Ancillary diagnostics include otoscopic examination, thoracic radiographs, or advanced imaging. Treatment and prognosis are determined by the etiology.

Résumé — Examen du syndrome de Horner chez les petits animaux. Le syndrome de Horner provient d’une dysfonction de la voie oculo-sympathique et est caractérisé par la miosis, l’enophtalmie, la protrusion de la troisième paupière et la ptose. Elle a été reconnue chez une grande variété de races et d’âges chez les patients petits animaux. La voie oculo-sympathique est une voie à trois neurones. Le neurone central/de premier ordre provient de l’hypothalamus et s’étend vers le bas sur la colonne vertébrale. Le neurone préganglionnaire/de deuxième ordre provient des trois premiers segments thoraciques de la colonne vertébrale et se déplace dans le thorax et la région cervicale jusqu’à la synapse au ganglion cervical crânien. Le neurone postganglionnaire/de troisième ordre se déplace de ce ganglion jusqu’à l’orbite. L’application topique de cocaïne est le test de référence pour la différenciation du syndrome de Horner des autres causes de miosis. La phényléphrine topique 1 % permet l’identification d’un syndrome de Horner postganglionnaire. Plusieurs étiologies ont été signalées pour le syndrome de Horner, mais la maladie idiopathique est la plus commune. Les diagnostics auxiliaires incluent l’examen otoscopique, des radiographies thoraciques ou une imagerie avancée. Le traitement et le pronostic sont déterminés par l’étiologie.

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Introduction

Horner’s syndrome is a phenomenon that arises from dysfunction of the oculosympathetic pathway and is characterized by the constellation of miosis, enophthalmos, protrusion of the third eyelid, and ptosis (Figure 1). It was described as early as 1727, when Francois Pourfour du Petit severed intercostal nerves in dogs and noted ipsilateral ocular effects (1). The classic combination of clinical signs was more fully described later, however, through the independent work of Claude Bernard and Johann Friedrich Horner (1,2).

Horner’s syndrome is well-known in small animal medicine and has the potential to affect any breed of cat or dog, although there is a lack of consensus on the population most likely to be affected. One study failed to identify breed predispositions (3) while another suggested that golden retrievers, Labrador retrievers, collies, Shetland sheepdogs, weimaraners, and Doberman pinschers are over-represented (4). A disparate age range can also be found in the literature, with patients presenting anywhere from 5 wk to 17 y of age in dogs, and up to 14 y of age in cats (5,6). It is therefore important to be able to recognize the signs,
understand the underlying neuroanatomy, possible differential diagnoses, available diagnostic tools, treatment options, and expected prognosis. It is on this basis that we provide this review.

**Neuroanatomy**

Sympathetic innervation to the eye is a 3-neuron pathway. The central or first order neuron begins within the hypothalamus and travels through the lateral tectotegmentospinal tract, which is located within the lateral funiculus of the spinal cord white matter (7–9). The synapse with the preganglionic/second order neuron begins within the gray matter of the first 3 thoracic spinal cord segments (T1, T2, T3). Its axon continues through the ramus communicans and travels though the thorax within the sympathetic trunk (2a). It will pass through but not synapse within the cervicothoracic ganglion (A) and middle cervical ganglion (B). The sympathetic trunk fuses with the vagues nerve and travels through the cervical region as the vagosympathetic trunk (2b), ultimately synapsing in the cranial cervical ganglion (C). The post-ganglionic axon will then enter the calvarium and continue to the orbit.

The axon of the preganglionic neuron exits the spinal cord segment with the ventral nerve root and travels a brief distance within the spinal nerve before separating as the ramus communicans just as the spinal nerve divides into the dorsal and ventral branches (Figure 3), lateral to the intervertebral foramen (10,11). The ramus communicans joins the thoracic sympathetic trunk ventrolateral to the vertebral bodies and as the sympathetic pathway travels cranially through the mediastinum it passes through the cervicothoracic ganglion, which is near the surface of the cranial lung lobe, and the middle cervical ganglion (10,11). The nerve does not synapse as it passes through either of these ganglia (Figure 2). At the level of the thoracic inlet the sympathetic trunk fuses with the vagues nerve within a common epineurium (12). This is in contrast to humans, in which the cervical sympathetic trunk and the vagues nerve are adjacent but distinct entities (13). The vagosympathetic trunk courses through the cervical region to the head where the sympathetic trunk once again deviates from the vagues nerve and terminates in the cranial cervical ganglion (9). The cranial cervical ganglion is located ventromedial to the tympanic bulla, and this is where the preganglionic axon synapses with the postganglionic/third order neuron cell body (14). The active neurotransmitter at the postganglionic axon synapses with the postganglionic/third order neuron cell body (14). The active neurotransmitter at the postganglionic cell body is acetylcholine, which is released by the preganglionic telodendria and binds to nicotinic cholinergic receptors on the postganglionic cell body (11).

Unfortunately, the exact pathway of the postganglionic neuron is not as well-defined as the more proximal portions. Once the axons exit the cranial cervical ganglion, they form a plexus around the internal carotid artery (11). Some of the fibers pass through the tympanic bulla on the ventral surface of the petrosal portion of the temporal bone while others run medial to the bulla before entering the calvarium (9,10). Postganglionic fibers may also continue with the internal carotid artery and enter the calvarium via the tympanooccipital fissure and carotid canal (9,15). Once within the calvarium, the postganglionic fibers course ventral to the trigeminal ganglion and exit with the ophthalmic branch of the trigeminal nerve through the orbital fissure (Figure 4), entering the orbit (9,10,15,16). The fibers become the nasociliary nerve and then ultimately the long ciliary nerve, which supplies the iris dilator muscle and blood vessels of the uveal tract (10). Fibers also supply the smooth muscles of the periorbita and the eyelids. The term orbitals
muscle (musculus orbitalis) has been inconsistently applied to this group of muscles, sometimes referring to the periorbital muscles alone and sometimes also including the muscles of the dorsal, ventral, and third eyelids (17). Cats have sympathetic innervation of the smooth muscles within the third eyelid, a feature that is absent in dogs (17). A portion of postganglionic fibers is designated to travel from the cranial cervical ganglion with the external carotid artery and supply arteries of the face and ears, as well as sweat glands (10). Norepinephrine is the primary neurotransmitter acting at the synapses between the postganglionic telodendria and the effector organs, binding to α-adrenergic receptors (11).

Clinical signs
Horner’s syndrome is classified based upon the level of dysfunction within the oculosympathetic pathway — central, preganglionic, or postganglionic — but the signs will be the same regardless of a lesion’s location in small animals. It should be noted that with a central lesion it is very unlikely that Horner’s syndrome will be the only observed clinical sign. Other expected neurological deficits with a brainstem or spinal cord lesion include altered mentation, paresis, postural reaction deficits, or dysfunction of other cranial nerves. Ataxia may also be observed with a central lesion. The character of the ataxia is most likely to be proprioceptive. This is due to concurrent involvement of the general proprioceptive pathways as they traverse through the spinal cord and brainstem, some of which travel within the lateral funiculus and are close to the tectotegmentospinal tract (9). If the underlying pathology is extensive enough, involvement of the central vestibular system may occur, and a more vestibular ataxia may be noted (9).

Miosis
Miosis of the affected eye is the most commonly identified component of Horner’s syndrome and develops secondary to loss of innervation of the iris dilator muscle (10). The iris sphincter muscle, which is innervated by the parasympathetic component of cranial nerve III, is then allowed to act unopposed and leads to pupillary constriction (18). The iris dilator muscle also has a unique feature in that it has dual innervation by both the sympathetic and parasympathetic systems (17). The sympathetic component is what allows the iris dilator muscles to contract and the pupil to dilate. The parasympathetic innervation conversely prevents contraction of this muscle. When the sympathetic pathway is compromised, the inhibitory effect of the parasympathetic innervation further prevents pupil dilation and exacerbates the miosis. (17). Anisocoria will develop with unilateral lesions and is most pronounced under scotopic conditions as the affected eye cannot dilate to the same degree as the normal eye (16). The properly functioning iris sphincter muscle, however, still allows the affected eye to fully constrict under photopic conditions. Indeed, the anisocoria may actually be difficult to appreciate in a brightly lit room. Pupillary light reflexes and vision will remain intact in the affected eye (18).

Ptosis
Ptosis, or drooping of the upper eyelid, leads to a narrowed palpebral fissure in the affected eye (14). The dogma is that ptosis develops because of loss of sympathetic tone in the thin muscles of the eyelids (occasionally referred to as Müller’s muscle) (1,2). There are some that argue, however, that this muscle is of minor importance in veterinary species and that the ptosis is secondary to enophthalmos (3,10).
Enophthalmos
The circular periorbital smooth muscles help maintain the globe in an anterior position within the orbit (9,17). When these muscles relax due to a loss of sympathetic input, the retractor bulbi muscles are without antagonism and they actively retract the globe into the orbit, producing enophthalmos (10,14,18). The absence of the retractor bulbi muscle in humans results in ptosis only (19).

Third eyelid protrusion
Although the degree to which the third eyelid protrudes is variable between cases, it is the second most commonly reported clinical sign (3). The protrusion is passive in dogs and secondary to the enophthalmos (14). In cats there is an additional active component due to the presence of sympathetically mediated smooth muscle within the third eyelid. With a Horner’s lesion, the muscle can no longer maintain the eyelid in a retracted position (16,17).

Vascular effects
A loss of sympathetic input can lead to ipsilateral peripheral vasodilation, although this is an uncommonly reported manifestation in small animals (16). The vasodilation may manifest as a warm pinna or hyperemia of the nasal planum and/or conjunctiva (14,20). There is 1 report of a seal point Siamese cat with loss of pigment from the mask on the side of its face (20). The discoloration was attributed to a local increase in temperature and reduced temperature-dependent melanocyte activity following vasodilation (14,20).

Partial Horner’s
An incomplete or partial Horner’s syndrome is well-described in humans and is characterized by ophthalmic signs (miosis and ptosis) without facial anhidrosis; one of the cardinal signs amongst human patients (19,21). These cases are seen with postganglionic lesions and are often associated with internal carotid artery dissection, due to the close association of sympathetic fibers with the internal carotid adventitia (21). Reference is made to a partial Horner’s in dogs with brachial plexus lesions in which only a miosis is seen, but a suitable anatomical explanation has not been provided (16). Miosis is also associated with acute forebrain and midbrain disease, although it is unknown if this is due to loss of sympathetic function (a partial Horner’s) or due to loss of upper motor neuron inhibition of the oculomotor nerve (9).

Differential diagnoses
Neuro-ophthalmology is a uniquely challenging arena, perhaps related to the complexity of the anatomy and the diversity of diagnostic tests and etiologies. Although seemingly simple, the first task a clinician faces with anisocoria is determining which pupil is abnormal. This involves the recording and comparison of pupil size in both photopic and scotopic conditions. Generally, the non-mobile pupil is the abnormal one and with unilateral Horner’s syndrome the anisocoria is less obvious in photopic conditions and worsens substantially in scotopic conditions, related to a lack of dilation in the latter by the affected pupil. It is an important distinction to make as the differentials for mydriasis are quite different from those for miosis. For example, iris atrophy, glaucoma, Adie’s syndrome, and cavernous sinus syndrome may be important considerations for a mydriatic pupil and would require a different complement of ancillary diagnostics (22).

Once the miotic pupil is determined to be the abnormal one, the important differential diagnoses for Horner’s syndrome include undetected unilateral or bilateral uveitis, endophthalmitis, panophthalmitis, and focal ulcerative keratitis. These conditions can be excluded by a thorough ophthalmologic examination. Based on our experience, mild uveitis as a primary condition, or one that develops secondary to focal ulcerative keratitis, is overlooked most frequently by veterinarians. Like Horner’s syndrome, it may be bilateral or unilateral, and typically is very mild in cases of either a primary uveitis or a uveitis that develops secondary to a focal subclinical corneal ulcer and is usually accompanied by conjunctival and episcleral hyperemia. Conjunctival hyperemia is generally not present in Horner’s syndrome in domestic animals. The intraocular pressures are usually reduced with uveitis and the pupils usually dilate fully when topical parasympatholytics are applied to subtle cases of uveitis, while in cases of Horner’s syndrome pupils will only dilate by a very small amount. These are important but subtle ophthalmologic findings that reward the thorough clinician. Additional findings include mild aqueous flare, synecchia, uveal follicles, granulomas or tumors, and corneal scars, vascularization and edema, which are all important signs of uveitis and keratitis, respectively. For those clinicians who have dilated the pupil with a topical parasympatholytic agent it is important to recognize that the miotic pupil with Horner’s syndrome will only dilate by a millimeter or so (pupillary escape) as the residual parasympathetic tone is released in the affected globe.

| Table 1. Summary of pharmacological diagnosis and localization of Horner’s syndrome. |
|---|---|---|---|
| Drug | Mechanism of action | Use | Effect |
| Cocaine (5% or 10%) | Prevents norepinephrine reuptake | Confirm Horner’s syndrome | Dilates Horner’s pupil |
| | | | No effect on normal pupil |
| Apraclonidine (0.5% or 1%) | Weak α-1 adrenergic agonist | Confirm Horner’s syndrome | Dilates Horner’s pupil (not validated in veterinary patients) |
| Phenylephrine (0.1% or 1%) | Direct sympathomimetic | Localize Horner’s syndrome | Dilates with postganglionic lesion < 20 min |
| | | | No effect on preganglionic, central lesions or normal eye |
| Hydroxymetamphetamine (1%) | Indirect sympathomimetic | Localize Horner’s syndrome | Dilates with preganglionic or central lesion, normal eye < 45 min |
| | | | No effect on postganglionic lesion |
Diagnostic testing
The gold standard test for Horner’s syndrome in all animals is the topical application of 1 drop of a 5% or 10% solution of cocaine (23). Cocaine prevents the reuptake of norepinephrine by the presynaptic membrane of the postganglionic neuron, leading to pupillary dilation (24). A lesion affecting any part of the oculosympathetic pathway will prevent the normal release of norepinephrine, which means that even in the face of cocaine there is insufficient accumulation of norepinephrine within the synapse to affect pupil size. In bilateral Horner’s cases neither pupil will dilate substantially with topical cocaine and unilateral cases will manifest with worsening anisocoria as the affected pupil will dilate minimally and the unaffected pupil will completely dilate (25). Cocaine testing in humans will confirm the diagnosis of Horner’s when the anisocoria exceeds 0.8 mm (24,25). Although cocaine testing is diagnostic it unfortunately does not localize the sympathetic pathway lesion. It is often not completed by veterinary ophthalmologists as the product is a strictly controlled substance and the ophthalmic solution must be compounded. Additionally, it requires a separate visit without parasympatholytic ocular application to be diagnostic. Many ophthalmologists simply use the minimal dilation of the miotic pupil to parasympatholytics and the complete ophthalmologic examination to rule out subtle uveitis and keratitis.

Apraclonidine has been used with increasing frequency in human medicine due to the challenges of working with cocaine. It has a weak α-1 adrenergic effect and when applied topically a normal pupil will be minimally affected while a Horner’s syndrome pupil will dilate (26,27). This dilatory effect is seen with both pre- and postganglionic lesions (27); the respective reduction or complete absence of norepinephrine release induces upregulation of α receptors on the postsynaptic membrane of the iris dilator muscle (26,27). The up-regulation could be the result of an increased number of α receptors, reduced degradation or reduced absorption of catecholamines within the synapse, a phenomenon known as denervation hypersensitivity (16,28). The purpose of this response is to maximize the opportunity for activation of the effector organ in the face of insufficient neurotransmitter. The overall effect of 0.5% to 1% apraclonidine is a lessening of the anisocoria within 30 to 45 min (24–27). While used to treat glaucoma, apraclonidine has not been validated for diagnosing Horner’s syndrome in veterinary patients and may induce mydriasis in a normal eye (29).

Pharmacological localization of Horner’s lesions
Considerable confusion exists amongst veterinary clinicians and in the veterinary literature regarding the techniques for localization of Horner’s syndrome. Given the diversity of systemic and local periocular conditions that can induce Horner’s syndrome we stress the importance of a complete approach to localization that is usually completed in 2 or 3 visits depending on the availability of cocaine for initial confirmation of the diagnosis. We have provided a guide for pharmacologic localization in Table 1.

### Table 2. Etiologies for Horner’s syndrome.

<table>
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<tr>
<th>Location</th>
<th>Etiology</th>
<th>Number of animals</th>
<th>Reference</th>
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<tr>
<td></td>
<td>Neuroblastoma</td>
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<td>32</td>
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<tr>
<td></td>
<td>Carotid body paraganglioma</td>
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<td>Post-operative TECA-LBO</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Infectious</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Otitis media/interna</td>
<td>22</td>
<td>28,33</td>
</tr>
<tr>
<td>Preganglionic</td>
<td>Idiopathic</td>
<td>112</td>
<td>28,33–35</td>
</tr>
<tr>
<td></td>
<td>Iatrogenic</td>
<td></td>
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<tr>
<td></td>
<td>Brachial plexus block</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Epidural ropivacaine</td>
<td>1</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>Vagus nerve stimulator placement</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Thoracic surgery</td>
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<td>37,8</td>
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<td></td>
<td>Traumatic</td>
<td></td>
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<td></td>
<td>During birth</td>
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<td>5</td>
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<tr>
<td></td>
<td>Brachial plexus avulsions</td>
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<td>3,39</td>
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<tr>
<td></td>
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<td></td>
<td>Mediastinal lymphoma</td>
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<td>40</td>
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<tr>
<td></td>
<td>PNST of vagus nerve</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Infection</td>
<td></td>
<td></td>
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<td>Tick paralysis — <em>Ixodes holocyclus</em></td>
<td>2</td>
<td>41</td>
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<tr>
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<td>Traumatic</td>
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<tr>
<td></td>
<td>Air pellet — spinal cord</td>
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<td>42</td>
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<tr>
<td></td>
<td>Infectious</td>
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<tr>
<td></td>
<td>Neospora</td>
<td>1</td>
<td>43</td>
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<tr>
<td></td>
<td>Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fibrocartilagenous embolism — cervical</td>
<td>1</td>
<td>10</td>
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<tr>
<td>Unspecified</td>
<td>Diabetic polyneuropathy</td>
<td>1</td>
<td>44</td>
</tr>
</tbody>
</table>

TECA-LBO — total ear canal ablation and lateral bulla osteotomy; PNST — peripheral nerve sheath tumor.
Third order Horner’s syndrome that is unilateral is by far the most common presentation and localization of such a lesion is best accomplished by the application of a dilute direct sympathomimetic (phenylephrine) (28). A drop of 1% phenylephrine will create pupillary dilation and resolve enophthalmos, third eyelid protrusion, and ptosis in under 20 min, while it will not dilate the normal canine, feline, or equine pupil or a first or second order Horner’s pupil (28,30). This is due to the denervation hypersensitivity following absence of endogenous norepinephrine in the affected eye. It is important to use such a dilute solution to ensure that only a hypersensitive pupil will respond, as even a normal pupil may dilate at higher concentrations (3,10,28). While 1% is most commonly reported in the veterinary literature, the authors have also had success using a 0.1% solution of phenylephrine. It is imperative that the phenylephrine be applied bilaterally and simultaneously; in unilateral cases the normal eye will not respond within the 20 min, acting as a control to confirm the hypersensitivity of the affected eye. When the Horner’s syndrome is bilateral, both eyes will still respond and the resolution of signs is still expected within 20 min.

When the Horner’s syndrome has been present for longer than 3 wk and a pupil fails to respond to 1% phenylephrine, one assumes a first or second order lesion. Bilateral application of 1 drop of 10% phenylephrine is pursued and again the response is timed. Both the normal and affected pupil should dilate within 20 to 40 min.

As discussed, dilation of the pupil is noticed sooner and with a lower concentration of phenylephrine with a postganglionic lesion. A possible explanation for this is that when the postganglionic neuron is affected there is a complete depletion of norepinephrine within the synapse, leading to maximum sensitivity of the post-synaptic membrane to exogenous adrenergics (28). When the lesion is preganglionic, however, small quantities of norepinephrine continue to be released by the still-functional postganglionic neuron. While a degree of denervation hypersensitivity is still present it is not as complete and thus the response to topical adrenergics is not as pronounced (28).

It is very important that the clinician be cognizant of the time required for denervation hypersensitivity to develop when using phenylephrine to localize a Horner’s syndrome. If testing is conducted before onset of the hypersensitivity, a case could be falsely localized as preganglionic. Unfortunately, there is variability in the literature regarding the time of onset of denervation hypersensitivity, with ranges as wide as 2 to 10 d and 2 to 3 wk being reported (6,18). Many of the sources cited are also review articles. The authors of this review paper use 2 to 3 wk to help reduce the likelihood of a false negative result. The same concerns exist for the use of apraclonidine, although this has not been referenced in veterinary medicine. Another marked area of ambiguity in the literature is why apraclonidine induces pupillary dilation with either second or third order lesions, while dilute phenylephrine only acts with third order lesions, even though both pharmacological agents rely on denervation hypersensitivity.

Hydroxyamphetamine (1%) is an alternative method of distinguishing a third order from a first and second order lesion. As an indirect sympathomimetic it will stimulate the release of norepinephrine from the intact postganglionic nerve terminal, thus leading to pupil dilation in normal eyes and those affected by a first or second order lesion (18). The dilation should be noted within 45 min. An affected postganglionic neuron (a third order lesion), however, has a reduced or absent supply of norepinephrine and the pupil will not dilate (10). Concerns have been raised, however, regarding increased rates of false negative or false positive results when compared to dilute phenylephrine (16).

There has yet to be developed a pharmacological method for differentiating a first and second order Horner’s syndrome (24). As a reminder, the development of a first order lesion in the absence of other thalamic, brainstem or myelopathic deficits is very unlikely (16).

Etiologies of Horner’s syndrome

Once a diagnosis of Horner’s syndrome has been made and the lesion localized to a postganglionic, preganglionic, or central location, the underlying etiology must be considered. Case reports have documented an astonishing array of possibilities, including those that are idiopathic, iatrogenic, neoplastic, traumatic, and infectious in nature. A summary of described etiologies is provided in Table 2.

Idiopathic Horner’s syndrome

Idiopathic Horner’s syndrome merits specific discussion as it represents approximately half of the presentations amongst dogs (14). Although any breed can be affected, golden retrievers are predisposed with an incidence of 2.6% compared with other breeds at 0.03% (33,34). Collies may also be at increased risk (35). A mean age of 5 to 8 y is commonly reported in the literature, although animals between the ages of 4 and 13 y have been affected (3,33,34). Of Horner’s syndrome cases documented in cats, approximately 40% are idiopathic (3). Clinical signs are acute in onset, can be unilateral or bilateral, and can be due to both pre- and post-ganglionic lesions (16). As the name suggests, an underlying cause has not been identified and a diagnosis of idiopathic Horner’s syndrome can only be made after excluding all other possible causes. It is not unreasonable, however, to make a presumptive diagnosis in a patient with an acute onset of signs, an unremarkable physical examination and the absence of other neurological deficits (16).

Ancillary diagnostics

Further diagnostics are often warranted to investigate the etiology of Horner’s syndrome, and they are dependent on the location of the lesion as determined by the previously described pharmacological testing. In cases of post-ganglionic lesions, a thorough otoscopic examination should be done to evaluate for any evidence of otitis (45). A complete blood (cell) count and serum biochemistry are advisable, particularly since metabolic disorders such as diabetes mellitus have been associated with Horner’s syndrome in a dog (44). Cervical and thoracic radiographs are indicated in cases of preganglionic lesions. Magnetic resonance imaging (MRI) is warranted in all cases of central lesions, but advanced imaging (computed tomography (CT) or
MRI] should also be considered when preliminary diagnostics fail to identify a cause in pre- and post-ganglionic cases as this will allow for complete evaluation of the oculosympathetic pathway as it traverses through the brain, spinal cord, mediatinum, neck, middle ear, and orbit. If a structural lesion can be identified, more invasive diagnostics such as myringotomy/bulla osteotomy with cerebrospinal fluid analysis or biopsy of masses may be required to determine the definitive etiological agent.

**Treatment and prognosis**

The treatment and prognosis of Horner’s syndrome are obviously dependent upon the underlying etiology. It is possible that the degree of third eyelid protrusion will be enough to obscure patient vision, in which case symptomatic treatment with topical 1% or 10% phenylephrine can be used for short-term improvement of signs (16,33,34). Some animals will only show partial resolution of the signs, such as the ptosis and enophthalmos, but will have persistent miosis (6). When permanent deficits occur, they are largely considered to be cosmetic with minimal to no impact on the patient’s quality of life (16).

Given that there is no specific etiology for idiopathic Horner’s syndrome, there is no specific treatment. There is 1 report of using acupuncture to treat a dog with presumptive idiopathic disease (46). Two points were used without electrical stimulation and the needles were retained for 20 min. The signs had improved the day following treatment and the signs resolved within 3 d (46). It is important to remember that most cases of idiopathic Horner’s syndrome will show spontaneous improvement in as little as 4 wk, although some dogs may not improve until 15 wk after onset (28,35). It is also unusual for dogs to have repeat episodes (28).

There is marked variability in the literature regarding the prognosis when Horner’s syndrome is the result of iatrogenic and spontaneous injury. In 2 cases in which the inciting cause was application of local anesthetics (brachial plexus block, epidural), the signs completely resolved within several hours (8,36). Cats are at increased risk for developing Horner’s syndrome following bulla osteotomies compared to dogs, with incidence rates of 58.3% and 3.3%, respectively (7). Post-operative signs tend to last 2 wk in dogs, while up to 25% of cats will have a permanent Horner’s syndrome. Horner’s syndrome secondary to thoracic surgery is likely to improve (37,38). Signs of Horner’s syndrome can resolve following a brachial plexus injury, although resolution of the Horner’s syndrome itself is not associated with return of function in the affected limb (39).

In cases of infectious disease, resolution of the Horner’s syndrome is possible if the underlying cause is appropriately addressed (43,44). Permanent signs are, not surprisingly, associated with neoplasia of the oculosympathetic pathway (21).

In conclusion, Horner’s syndrome manifests with consistent clinical signs that include ptosis, enophthalmos, miosis, and third eyelid prolapse. The lesions that induce Horner’s syndrome are diverse and include inflammatory lesions, neoplasms, and trauma; these may all cause central, preganglionic or postganglionic lesions. Topical ophthalmic cocaine is the gold standard diagnostic test to confirm the presence of Horner’s syndrome, although it is seldom used even in veterinary referral practice.

Localization of the lesion to the specific location within the oculosympathetic pathway involves bilateral topical application of initially dilute followed by more concentrated topical direct adrenergics with timed responses to the resolution of the signs. Indirect sympathomimetics may provide further support of lesion localization. While idiopathic disease is the most common cause of Horner’s syndrome, many other etiologies exist and necessitate additional diagnostics such as radiographs, CT, or MRI. These steps will accurately identify the lesion location and may allow the clinician to confirm the etiology of the oculosympathetic lesion.

**References**


Hypoplastic right ventricle in a dog
Alaina Macdonald

Abstract — A 7-week-old male crossbred puppy was presented in acute respiratory distress. A diagnosis of left- and right-sided heart failure was confirmed on postmortem examination. The heart had a severely hypoplastic right ventricle. Hypoxemia and ischemia are postulated to be the result of cardiac decompensation.


This is an example of a congenital cardiac defect resulting in acute decompensation and heart failure. Postmortem examinations are a valuable learning tool following cases exhibiting clinical conditions of undetermined etiology.

Case description
A 7-week-old male collie mixed-breed dog was presented to Heartland Animal Hospital in Listowel, Ontario with acute onset dyspnea. The entire litter of puppies was obtained by the client the night before presentation; no prior history was available. The new owner applied selamectin (Revolution; Zoetis, Kalamazoo, Michigan) topically to each puppy the previous night at an unspecified dose. The puppy developed dyspnea and was poorly responsive the morning of presentation, while his littermates remained apparently normal.

On presentation, physical examination revealed pale mucous membranes, tachypnea with shallow respiration, a quiet attitude, distended abdomen, palpable jugular pulses, and a grade 4/6 heart murmur audible on both sides. Radiographs showed decreased serosal detail in the abdomen, increased radiopacity bilaterally in the lungs with a bronchointerstitial pattern, an enlarged liver, and an enlarged, asymmetrical and globoid heart. The puppy was euthanized due to a poor prognosis.

A full postmortem examination was conducted with the assistance of Drs. Jeff Caswell and Laura Bassel (Pathobiology Department, Ontario Veterinary College). Gross postmortem findings revealed a markedly enlarged liver and a small amount of serous fluid in the abdomen. The lungs were mottled, red and tan, and were wet and heavy. The heart was severely enlarged and lacked obvious subsinuosal and paraconal grooves. The right ventricle was markedly small, with approximately 8 to 10 mm of chamber present below the atrioventricular valves. The walls were thin, measuring approximately 3 to 4 mm thick. The pulmonary outflow tract was mildly stenotic. The left ventricle appeared abnormally thick, and the muscles had multifocal pale streaks affecting 3% to 5% of the tissue, most prominently in the papillary muscle. The aortic outflow tract and coronary arteries appeared normal, and there was no evidence of a ventricular septal defect, overriding aorta, foramen ovale, or other congenital cardiac anomalies (Figure 1). Tissues from several organs were submitted for histopathology at the Animal Health Laboratory in Guelph, Ontario.

Figure 1. Gross examination of the heart revealed a hypoplastic right ventricle with a normal atrium, mildly stenotic pulmonary outflow tract, and no evidence of other congenital cardiac anomalies.
Figure 2 shows histopathological findings in the left and right ventricles, liver, and lung. The left ventricle and interventricular septum had random multifocal regions of myocardial necrosis and mineralization, encompassing < 5% of the tissue. The left papillary muscle exhibited sections of more pronounced mineralization and cardiomyocyte necrosis. The right ventricle had small, wavy, disorganized cardiomyocytes and poorly demarcated areas of acute necrosis without evidence of mineralization. The right atrium also contained areas of cardiomyocyte necrosis without mineralization. Sections of the liver showed passive congestion, capillarization of sinusoids, and necrosis in several areas. Lung sections contained multifocal atelectasis throughout, as well as free-floating alveolar macrophages, a minority of which were identified as hemosiderophages by a Perl's iron stain. The bone marrow had increased cellular density and a ratio of erythroid to granulocytic lineage of approximately 1:1. Frequent fetal glomeruli were found throughout the cortex. These findings culminated in a histological diagnosis of multifocal myocardial necrosis and mineralization, severe pulmonary edema with hemosiderophages, chronic hepatic congestion with periportal necrosis and hepatocellular atrophy, and erythroid hyperplasia. Ultimately, the clinical and necropsy findings were verified by histopathology, and the final diagnosis indicated both left- and right-sided heart failure.

Discussion
Cardiac development in the fetus occurs early in gestation (1) and an infectious or toxic insult at this time may have resulted in the development of the observed anomalies. However, the apparent health of the other puppies argues against the possibility of a teratogenic cause. Furthermore, the absence of fibrosis suggests that hypoplasia, rather than atrophy or necrosis, was the causative process.

Congenital cardiac anomalies in dogs are well-recognized in the veterinary literature, and appear to be influenced by genetics (2,3). The prevalence of congenital heart defects in young mixed breed dogs in a large study was 0.13%; reports in populations containing purebred dogs are variable but consistently indicate a higher prevalence (4). Historically, the most common anomalies include pulmonic stenosis, patent ductus arteriosus, subaortic stenosis, and ventricular septal defect (4). Data related to hypoplastic right ventricle in the veterinary literature are sparse, and despite many studies in young dogs, reports of this condition appear limited to calves (5). We cannot be sure whether this finding is truly unique, or rather represents unusual and remarkable survival of a dog with a severe heart anomaly.

Clinical, radiographic, and histologic signs of both hepatic and pulmonary congestion indicate the presence of decompen-sated heart failure. Given the consistent evidence of cardiomyocyte necrosis and mineralization, it is hypothesized that failure of the right ventricle to adapt to physiological stress culminated in lack of blood flow to the lungs, hypoxemia, and eventually ischemia. The relatively more pronounced necrosis and mineralization of the left papillary muscle lends support to this theory, as it is the most active heart muscle and therefore most susceptible to hypoxia (6). A similar association between
papillary muscle necrosis, hypoperfusion of the myocardium, and early mortality is hypothesized in human neonates (6).

Alternative considerations for the acute cardiac necrosis include ionophore toxicity (7). However, given the apparent health of the littermates, lack of historical exposure to ionophores, and the lesions noted on postmortem examination, the hypoplastic right ventricle appears to be the cause of cardiac failure.

To the author’s knowledge, this is the first reported case of a hypoplastic right ventricle in a dog. The apparent health of the littermates, presenting clinical signs, and postmortem findings do not support a toxic or infectious cause; therefore, this condition is believed to be congenital.

Acknowledgments

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References


Answers to Quiz Corner

Les réponses du test éclair

1. D) The glucose within the lens overpowers the hexokinase pathway, causing the excess glucose to be converted to sorbitol within the hexose-mono-phosphate shunt. The sorbitol is trapped within the lens, causing an increase in osmotic pressure that draws fluid into the lens and swells the lens fibers.

D) La concentration alvéolaire minimale est une mesure de la puissance d’un anesthésique qui exige la plus basse concentration pour permettre l’anesthésie. La vitesse à laquelle un anesthésique travaille est dépendante de la solubilité. La vitesse de l’évaporation de l’anesthésique dépend de la pression de la vapeur; une pression élevée égale une évaporation rapide.

2. B) Lufenuron (Program) is an insect development inhibitor that interferes with chitin synthesis and arrests flea exoskeleton development. Adult fleas pass lufenuron transovarially to the developing flea egg, which either does not hatch or dies during the first molt.

B) Le lufenuron est un inhibiteur du développement de l’insecte qui interfère dans la synthèse de la chitine et arrête le développement de l’exosquelette de la puce. Les puces adultes transmettent le lufenuron par voie transovarienne à l’œuf de la puce en développement qui n’éclos pas ou meurt au cours de la première mue.

3. D) MAC is a measure of an anesthetic’s potency or the anesthetic that requires the lowest concentration to achieve anesthesia. How fast an anesthetic works is dependent on the solubility. How fast an anesthetic evaporates depends on the vapor pressure; high vapor pressure equals fast evaporation.

4. B) This dog could have hyperadrenocorticism based on these results. Further testing is necessary. Elevation of the UCCR may be caused by hyperadrenocorticism, but may also be elevated as a result of stress or other nonadrenal illness. The clinical signs and elevated UCCR do not suggest hypoadrenocorticism.


5. B) N. caninum can infect cattle and cause abortion.

B) N. caninum peut infecter les bovins et causer des avortements.
The true cost of credit: Student debt and repayment

Le coût réel du crédit : dette étudiante et remboursement

Chris Doherty

Becoming a veterinarian is a long, and expensive undertaking. After 7 to 8 years of post-secondary education, it is not surprising that the average Canadian veterinarian graduates with $65,000 in student debt. In addition to this debt; however, the decisions made in its repayment can dramatically alter the true cost of credit.

The 2018 Provincial Surveys of Compensation and Benefits for Associate Veterinarians included a section specifically for recent graduates; those who graduated from Veterinary College in 2017 or 2018. This section asked about student debt, monthly expenses, and other topics of relevance to new graduates.

This survey found that 80% of recent graduates finished their educational careers with debt. For domestic students, the median debt upon graduation was $65,000. For international students (those students who were required to pay international student tuition), the median debt load was $250,000 (Table 1).

Across Canada, almost all recent graduates were employed, with a median annual compensation of $77,000. This figure excludes those employed as interns or residents, which typically carries a significantly lower compensation (Table 2).

Using the Canada Revenue Agency Payroll Deduction Calculator and taking the average provincial income tax rate across Canada, a gross annual income of $77,000 equates to a monthly after-tax income of $4627 (or $55,524/year).

Recent graduates were then asked to outline their monthly expenditures for expenses such as rent, groceries, utilities,

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transportation. For example, the average recent graduate spent $925 on rent/mortgage and $306 on food each month. The total monthly expenditure was an average of $2328. Note that this figure excludes repayment of student debt.

When asked about student loan repayment, those students who graduated with debt were paying it down aggressively. The median student debt repayment of recent graduates was $1000 per month. Assuming a $65 000 debt burden, at an interest rate of 4.95%, the minimum monthly payment on a 10-year amortization schedule would be $688, suggesting that the average recent graduate is paying 45% more than required (Table 3).

While this overpayment is laudable, it still leaves a significant amount of money that recent graduates can use in retiring their debt. With an after-tax income of $4627, monthly expenditures (excluding student debt repayment) are $2328, leaving a surplus of $2328 – $2328 = $0. This leaves a significant amount of money that can be used to retire debt.

Table 1/Tableau 1. Median student debt upon graduation of 2017 and 2018 graduates stratified by domestic and international students./Dette étudiante médiane des diplômés de 2017 et de 2018 au moment de l’obtention du diplôme stratifiée en fonction des étudiants canadiens et internationaux.

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<td>Domestic students</td>
<td>$65 000</td>
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</tr>
<tr>
<td>Étudiants canadiens</td>
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<td></td>
</tr>
<tr>
<td>International Students</td>
<td>$250 000</td>
<td>9</td>
</tr>
<tr>
<td>Étudiants internationaux</td>
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<td></td>
</tr>
</tbody>
</table>

Table 2/Tableau 2. Median annual compensation of 2017 and 2018 graduates employed full-time./Rémunération annuelle médiane des diplômés de 2017 et de 2018 travaillant à temps plein.

<table>
<thead>
<tr>
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<th>Number of respondents</th>
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<tbody>
<tr>
<td>Rémunération annuelle médiane</td>
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</tr>
<tr>
<td>Temps plein (excluant les internes et les résidents)</td>
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</tbody>
</table>

Table 3/Tableau 3. Median monthly after-tax income, mean monthly expenditures (excluding student debt repayment), median student debt repayment, and remaining monthly balance for 2017 and 2018 graduates./Revenu mensuel médian net d’impôt, dépenses mensuelles médianes (en excluant le remboursement de la dette étudiante), remboursement médian de la dette étudiante et solde mensuel pour les diplômés de 2017 et de 2018.

<table>
<thead>
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<th>Amount Montant</th>
<th>Monthly after-tax income</th>
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<tbody>
<tr>
<td>Monthly expenditures excluding student debt repayment</td>
<td>$2328</td>
<td></td>
</tr>
<tr>
<td>(rent, food, utilities, etc.)</td>
<td>$2328</td>
<td></td>
</tr>
<tr>
<td>Dépenses mensuelles excluant le remboursement de la dette étudiante (loyer, nourriture, services publics, etc.)</td>
<td>$2328</td>
<td></td>
</tr>
<tr>
<td>Student debt repayment</td>
<td>$1000</td>
<td></td>
</tr>
<tr>
<td>Remboursement de la dette étudiante</td>
<td>$1000</td>
<td></td>
</tr>
<tr>
<td>Remaining monthly balance</td>
<td>$1299</td>
<td></td>
</tr>
<tr>
<td>Solde mensuel</td>
<td>$1299</td>
<td></td>
</tr>
</tbody>
</table>

En utilisant le Calculateur en direct de retenues sur la paie de l’Agence du revenu du Canada, on constate qu’un revenu annuel brut de 77 000 $ équivaut à un revenu mensuel net d’impôt de 627 $ (soit 55 524 $/année).

Nous avons ensuite demandé aux diplômés récents de présenter leurs dépenses mensuelles, y compris le loyer, l’épicerie, les services publics et le transport. Par exemple, le diplômé récent moyen dépensait 925 $ pour son loyer/hypothèque et 306 $ pour la nourriture chaque mois. Les dépenses mensuelles totales s'établissaient à une moyenne de 2328 $. À noter que ce chiffre exclut le remboursement de la dette étudiante.

Les étudiants qui ont répondu aux questions à propos du remboursement de la dette ont affirmé qu'ils s’attaquaient à la dette. Le remboursement médian de la dette étudiante des diplômés récents était de 1000 $ par mois. En supposant une dette de 65 000 $, à un taux d’intérêt de 4.95 %, le paiement mensuel minimum sur un amortissement de 10 ans serait de 688 $, ce qui suggère que le diplômé récent moyen paie 45 % de plus qu’il n’est nécessaire (Tableau 3).

Même si ce remboursement est admirable, il reste toujours un montant considérable dont les diplômés récents pourraient se servir pour régler leur dette. Avec un revenu net d’impôt de 4627 $, des dépenses mensuelles de 2328 $ et un remboursement de la dette étudiante de 1000 $, il y a un surplus mensuel de 1299 $.

Au rythme de remboursement moyen actuel, il faudra compter plus de six ans pour que les diplômés récents règlent une dette de 65 000 $ à un taux d’intérêt de 4.95 %, ce qui représente un coût de près de 11 000 $ en intérêts. Cette situation est toutefois préférable au paiement minimum requis qui comporterait plus de 17 000 $ en intérêts.

Cependant, en augmentant ce remboursement de 50 % pour le faire passer à 1500 $, il est possible de réaliser des économies additionnelles importantes, car la dette est maintenant réglée en quatre ans, ce qui permet d’économiser 4000 $ en intérêts (Tableau 4).
of $2328, and student debt repayment of $1000, there is a monthly surplus of $1299.

At the current average rate of repayment, it will take a recent graduate over 6 years, at a cost of nearly $11 000 in interest to retire a debt of $65 000 at 4.95% interest. This is preferable to the minimum required payment, which would incur over $17 000 in interest.

Bumping this repayment up by 50% to $1500, however, results in significant additional savings; the same debt burden now takes 4 years to repay and another $4000 of interest saved (Table 4).

For those recent graduates able to direct the entire unallocated monthly surplus of $2299 towards their student debt, a loan of $65 000 would be paid off in less than 3 years with an interest savings of more than $13 000, compared to the minimum required payment.

Once student loans are paid off, the saved interest can be put towards better uses, be it a vacation, car, down payment on a home, or savings and investing in a Registered Retirement Savings Plan or Tax-Free Savings Account. Any of these are preferable to simply forfeiting the money in exchange for the privilege of holding debt for a longer period of time.

This issue becomes even more pressing as the Bank of Canada continues to raise its benchmark interest rate, resulting in most student loans incurring greater interest. It wasn’t long ago that student loans at 3.95% interest were common; fast forward a few months and 5 interest rate hikes by the Bank of Canada, and 4.95% is closer to the norm today. Another 1% increase, to 5.95%, would push total interest incurred to more than $13 000, while an increase of 2% to 6.95%, would result in almost $17 000 in interest (Table 5).

Recent graduates would be well-advised to take advantage of the current relatively low interest rates, as the Bank of Canada has indicated further increases are likely coming. By controlling personal expenses, and paying down debt as fast as possible, new veterinarians can retain more of their hard-earned money, rather than handing it over as interest.

Further information
History and clinical signs

A 7-year-old spayed female shih tzu was examined by the ophthalmology service at the Western College of Veterinary Medicine. This dog was presented for a chronic history of red eyes and mild bilateral periocular discharge. The menace responses, and palpebral, oculocephalic, direct and consensual pupillary light reflexes were normal bilaterally. Schirmer tear test (Schirmer Tear Test Strips; Alcon Canada, Mississauga, Ontario) values were 18 and 17 mm/min in the right and left eyes, respectively. The intraocular pressures were estimated with a rebound tonometer (T onovet; Tiolat, Helsinki, Finland) and were 18 mmHg bilaterally. Fluorescein staining (Fluorets; Bausch & Lomb Canada, Markham, Ontario) of the corneas was negative bilaterally. On direct examination of both eyes there was mild mucoid periocular discharge. Following application of 0.5% tropicamide (Mydriacyl; Alcon Canada, Mississauga, Ontario), examination of both eyes using a transilluminator (Welch Allyn Finoff Transilluminator; Welch Allyn, Mississauga, Ontario) and handheld biomicroscope (Kowa SL-15 Portable Slit Lamp; Kowa, Tokyo, Japan) revealed multifocal white to yellow, subconjunctival masses affecting the palpebral conjunctiva of the upper and lower eyelids, mild conjunctival hyperemia, scattered superficial corneal vascularization and scarring, and a lackluster cornea. Indirect ophthalmoscopic (Heine Omega 200; Heine Instruments Canada, Kitchener, Ontario) examination was completed and did not reveal abnormalities in either eye. Photographs of the right eye at presentation are provided for your assessment and are also representative of the left eye (Figure 1).

What is your clinical diagnosis, differential diagnoses, therapeutic plan, and prognosis?

Discussion

The clinical diagnoses are multiple eyelid chalazia and a non-ulcerative keratitis. A chalazion is a firm, beige subconjunctival swelling resulting from meibomian duct obstruction, a subsequent accumulation of meibomian gland secretions, and eventual leakage into the surrounding tissue causing granulomatous inflammation. Secondary staphylococcal infection may be present in some cases requiring the use of topical and systemic antibiotics. The presence of chalazia is supportive of chronic meibomian gland dysfunction. Normal meibomian gland lipid is a clear, liquid oil, similar in appearance to vegetable oil. Conversely, abnormal meibomian secretions appear as a thick, turbid substance that can sometimes be expressed as coiled strands of inspissated lipid (1).

Differentials for a non-ulcerative keratitis include the presence of trichiasis (e.g., ectopic cilia, entropion), pigmentary keratitis, chronic superficial keratitis, keratoconjunctivitis sicca, and tear film quality disorders, among others. In this case, it is likely that chronic meibomian gland disease resulted in a subsequent deficiency in healthy, normal lipids in the tear film, which in turn lead to decreased tear film stability and increased evaporation of tears. Tear film breakup time is a test used clinically by veterinary ophthalmologists to evaluate tear film stability and the rate of tear evaporation. The normal breakup time in dogs should be at minimum 20 s (2,3); however, it is reported to be shorter in brachycephalic dogs (4,5). Reduced tear film breakup times are supportive of a tear film quality disorder related to either reduced meibomian gland or conjunctival...
goblet cell function. The tear film breakup time in this dog was approximately 6 s in both eyes, supportive of reduced tear film stability and quality. Clinical signs of a tear film quality disorder are similar to clinical signs of a quantitative tear disorder (i.e., keratoconjunctivitis sicca), but are often milder in nature. These clinical signs include mucoid periocular discharge, conjunctival hyperemia, corneal vascularization and pigmentation, and the appearance of a corneal surface that lacks luster.

Therapy for eyelid chalazia is incision and surgical curettage, followed by topical antibiotic application for 7 to 10 d. Warm compresses a few times daily may also improve blood flow to the affected eyelids and aid in resolution of focal granulomas. The prognosis is generally excellent following these interventions; however, recurrence or the formation of new chalazia is common (1).

Supportive therapies for tear film quality disorders originating from meibomian gland dysfunction include the frequent application of topical ointments containing lanolin, petrolatum, or mineral oil as they mimic the function of meibomian lipids in preventing tear evaporation (1). The frequency of application of these ointments should ideally be at least 4 times daily, though this is difficult for many owners to sustain long-term. Daily oral omega-3 fatty acid supplementation is increasingly recognized as an adjunctive therapy for meibomian gland dysfunction and dry eye in humans and animals (6–8). Cyclosporine A may also be useful in the therapy of tear film quality deficiencies as it has preliminarily been shown to aid in meibomian gland dysfunction in humans and in the restoration of conjunctival mucin production in dogs (9,10). The prognosis of tear film quality disorders varies according to severity and chronicity of disease, owner compliance, and elimination of underlying disease.

This dog had the chalazia of both eyes treated by surgical curettage followed by a 10-day course topical BNP ointment (BNP Ophthalmic Ointment; Vétoquinol, Lavaltrie, Quebec) 4 times daily. The dog was discharged with the recommendation of treating with oral omega-3 fatty acid supplementation once daily and cyclosporine A 0.2% (Optimmune; Merck Animal Health, Madison, New Jersey, USA) twice daily on a long-term basis.

References
Otitis externa is an inflammatory disease of the external ear canal, including the ear pinna. Otitis externa may be acute or chronic (persistent or recurrent otitis lasting for 3 months or longer). Changes that occur in the external ear canal in response to chronic inflammation may include glandular hyperplasia, glandular dilation, epithelial hyperplasia, and hyperkeratosis (1). These changes usually result in increased cerumen production along the external ear canal, which contributes to increase in local humidity and pH of the external ear canal, thus predisposing the ear to secondary infection.

The bacteria most commonly isolated from ear canals of dogs affected by otitis are *Staphylococcus* spp. (2). Other bacteria commonly associated with otitis include *Pseudomonas*, *Proteus*, *Enterococcus*, *Streptococcus*, and *Corynebacterium*. Some bacteria such as *Staphylococcus* and *Pseudomonas* may produce biofilm, which can lead to persistence of infection despite adequate therapy, as the biofilm needs to be disrupted for any antimicrobial therapy to be effective in clearing the infection. *Malassezia* yeast is another common component of otitis externa in dogs. Some dogs appear to develop an allergic response to *Malassezia* spp., leading to significant discomfort and pruritus.

Acute and uncomplicated otitis externa can often be treated successfully, but chronic or recurrent otitis externa is more challenging. Typically, underlying primary factors as well as predisposing and perpetuating factors are at play, including secondary otic infection. Repeated bouts of inflammation and...
infection can cause secondary changes in the ear canal that can ultimately lead to further lack of success in treating otitis, and possible end-stage ear disease. Severe glandular changes, fibrosis, stenosis, and calcification along the external ear canal lead to patient discomfort as well as progression of otitis from acute to chronic, and from straightforward to complicated otic disease. These changes are indicative of end-stage ear disease, that can usually be avoided with appropriate therapy for secondary and primary disease early in its progression. Client education and regular follow-up evaluations are key to prevention of end-stage ear disease.

**Clinical diagnosis and etiological factors**

Otitis externa is common in dogs, and may be unilateral or bilateral. Evaluation for otitis and its diagnosis is based on ear canal palpation, visual inspection of ears, including otoscopic examination, and cytological analysis of otic contents.

Changes to the ear pinna may include alopecia, exocytosis, crusting, erythema, and hyperpigmentation. The external ear canal may exhibit presence of hyperemia, ulceration, ceruminous or suppurative discharge, masses, stenosis, glandular changes, or foreign bodies. Usually more than one abnormal finding is noted within an affected ear. Evaluation of the tympanic membrane forms a key part of the otoscopic evaluation, though it may be difficult to assess the tympanum when otitis externa is present. It is reasonable to leave assessment of the tympanic membrane to a later date, after changes attributed to active otitis have been corrected.

Cytological evaluation of otic contents is the single most informative diagnostic test that helps with treatment of otitis. Otic cytological evaluations also help monitor response to therapy. Occasionally, bacterial culture sampling from the horizontal ear canal may be used to help determine treatment options and for selection of systemic antibiotic therapy, if indicated. Imaging studies such as radiographs, computed tomography (CT) scan or magnetic resonance imaging (MRI) are not routinely used but can be helpful in cases of chronic otitis, or when otitis media is of concern.

It is vital that the clinician evaluate involvement of various primary, predisposing, and perpetuating factors that may be contributing to ear disease while evaluating each individual patient affected by otitis externa. If all or most of these factors are identified, resolution of current otitis and prevention of future otitis episodes are likely.

**Primary factors**

Primary factors are diseases that have a direct effect on the external ear canal and can cause otitis, including otic parasites such as *Otodectes cynotis*, hypersensitivity disease [food allergy, atopic dermatitis, contact hypersensitivity (Figure 1)], endocrine disease such as hypothyroidism, otic neoplasia and foreign bodies. Underlying hypersensitivity disease is the most common primary factor leading to otitis in dogs (3).

**Predisposing factors**

Predisposing factors are factors that alter the local ear canal environment and create an increased risk for development of otitis externa. Ears with excessive hair, stenotic ears, increased cerumen production in the canals, otic masses, frequent ear cleaning, as well as changes in external environmental temperature and humidity can all act as predisposing factors.

**Perpetuating factors**

Perpetuating factors are factors that do not initiate inflammation but lead to exacerbation of the inflammatory process and maintain ear disease even if the primary factor has been identified and corrected. Bacteria such has *Staphylococcus* and *Pseudomonas*, and *Malassezia* yeast are common perpetuating factors. If infection travels to the tympanic bulla, presence of this infection in the middle ear can also act as a perpetuating factor, leading to recurrent external ear infections. Perpetuating factors are often the main reason for treatment failure in dogs affected by recurrent otitis externa.

**Treatment of otitis externa**

Effective treatment of ear infection includes treatment of infection and inflammatory changes as well as determination of the underlying factors that led to development of otitis in the first place. Topical therapy is the mainstay treatment for otitis externa although systemic use of anti-inflammatory therapy and/or antimicrobial therapy may be indicated for individual patients. Most dogs with otitis, irrespective of its cause, will benefit from anti-inflammatory therapy. Glucocorticoids can be used for a short duration to help with reduction of pain and swelling, thus helping with improved compliance for ear cleaning and medication administration. Glucocorticoids can also help disrupt biofilm formation and prevent development of chronic otic changes. Long courses or dependence on glucocorticoids for management of otic disease is not encouraged, unless it is necessary. Typically, systemic antibiotic therapy for treatment of otitis externa is discouraged.

While cytological analysis is very helpful with therapeutic decision-making and for monitoring response to therapy, simply treating otic infection may not always lead to a successful outcome. Cleaning ears before topical therapy is critical in helping decrease otic cerumen, thus allowing topical therapy to

![Figure 1. Contact hypersensitivity reaction to topical otic medication during treatment for otitis externa.](image)
be effective. Ear cleaning also helps break up the biofilm that may protect bacterial colonies from appropriate antimicrobial therapy. During treatment of otitis externa frequent patient re-evaluation, including otic cytology, is encouraged to determine if any changes are needed in treatment. A follow-up evaluation (including palpation, otoscopic examination, and ear canal cytology) to confirm complete resolution is very helpful in ensuring perpetuating or primary factors are not present at the time of completion of therapy. A recurrence of the problem despite documented resolution of otitis indicates need for a thorough review of possible underlying primary disease as well as predisposing and perpetuating factors.

**Otitis and hearing loss**

Dogs may develop hearing loss due to presence of otitis externa. Hearing loss can be classified as conductive, sensorineural, or mixed (combination of conductive and sensorineural). Sensorineural hearing loss may occur when the neurological (cochlea nerve) pathways of the brain are damaged by otitis interna, ototoxic medications (4), presbycusis, noise, physical trauma, general anesthesia, or infection (5,6). Conductive hearing loss may result from otitis related exudates, stenosis, or glandular hyperplasia (7). When hearing is affected in dogs with otitis externa, cleaning of exudates and debris from the external ear canals results in measurable improvements in hearing (8). As otitis externa resolves, an improvement in hearing can be noticed in dogs if it was due to changes related to the otitis. Deafness has been reported in dogs due to conductive hearing loss from presence of a mineral oil-based plasticized hydrocarbon gel otic medication in the ear canal (7). Otic medication was flushed out with improvement in brain stem auditory evoked response (BAER) test values in these patients.

As BAER testing is not usually available in companion animal practice, incidence and degree of hearing loss in dogs affected by otitis externa is difficult to assess. Some pet owners may clue in to symptoms and behavior related to hearing loss affecting their pet, while others may not. A pet-owner-based questionnaire to assess hearing loss may result from otitis related exudates, stenosis, or glandular hyperplasia (7). When hearing is affected in dogs with otitis externa, cleaning of exudates and debris from the external ear canals results in measurable improvements in hearing (8). As otitis externa resolves, an improvement in hearing can be noticed in dogs if it was due to changes related to the otitis. Deafness has been reported in dogs due to conductive hearing loss from presence of a mineral oil-based plasticized hydrocarbon gel otic medication in the ear canal (7). Otic medication was flushed out with improvement in brain stem auditory evoked response (BAER) test values in these patients.

As BAER testing is not usually available in companion animal practice, incidence and degree of hearing loss in dogs affected by otitis externa is difficult to assess. Some pet owners may clue in to symptoms and behavior related to hearing loss affecting their pet, while others may not. A pet-owner-based questionnaire to assess hearing loss in dogs affected by otitis has been developed and may be useful in assessment of hearing loss affecting dogs with chronic otitis with moderate to severe bilateral hearing deficits (5).

**Otitis media**

Otitis media is a common extension of external ear disease and occurs secondary to chronic otitis externa in up to 50% of cases (9,10). Chronic suppurative otitis is more commonly associated with middle ear disease than is erythematoc-cruminous otitis (10). Neurologic abnormalities such as head tilt, nystagmus, ataxia, and cranial nerve deficits may occur with otitis media and otitis interna (11). The absence of a tympanic membrane is suggestive of otitis media but adequate otoscopic examination can often be difficult to perform when concurrent otitis externa is present. An intact tympanic membrane does not rule out otitis media (12). Chronic otitis media has been associated with higher grades of hearing loss compared to hearing loss caused by otitis externa (5). The presence of material in the middle ear can be a perpetuating factor of otitis externa and a cause of therapeutic failure.

Referral to a veterinary dermatologist should be considered for all dogs that are presented with signs of recurrent otitis, chronic otitis, or otitis media. Video-otoscopic evaluation and deep ear treatments, with or without myringotomy sampling and medicated infusions, are often helpful in obtaining an accurate diagnosis and treatments that will prevent long-term complications associated with chronic ear disease. Imaging studies should also be considered for patients affected with otitis media. Radiography is of limited benefit and advanced imaging such as CT scan studies are preferred, if available, as they help evaluate for presence of middle ear infection, masses and bony changes to the tympanic bulla. Computed tomography studies are more sensitive and specific compared to radiography in diagnosing middle ear disease (13).

**Prevention of otitis externa and its complications**

Few effective preventive measures exist for otitis externa. Thoroug otic examination of all patients presented for a physical examination helps with early detection of mild and early cases of otitis. When dogs are presented with early ear disease, thorough client education and detailed diagnostic work-up, including frequent follow-up examinations, can help prevent development of complications that may lead to chronic otitis, hearing loss, otitis media, and end-stage ear disease.

**References**

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