The use of serum beta-hydroxybutyrate to determine whether nursery pigs selected on the basis of clinical signs are anorexic

Fixed-dose-rate administration of gemcitabine in cancer-bearing cats: A pilot study

Glove perforation rate with orthopedic gloving versus double gloving technique in tibial plateau leveling osteotomy: A randomized trial

Validation of noninvasive hemoglobin measurements using co-oximetry in anesthetized dogs

Antimicrobial resistance and beta-lactamase production of Escherichia coli causing canine urinary tract infections: Passive surveillance of laboratory isolates in Saskatoon, Canada, 2014

Attempted ultrasound-guided ethanol ablation of a suspected pancreatic pseudocyst in a dog

Disseminated yeast (Order Saccharomycetales) infection in a Muscovy duckling (Cairina moschata)

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Le mot du président

Principles of Veterinary Medical Ethics of the CVMA
Principes de déontologie médicale vétérinaire de l'ACMV

Veterinary Oath
“As a member of the veterinary medical profession, I solemnly swear that I will use my scientific knowledge and skills for the benefit of society. I will strive to promote animal health and welfare, relieve animal suffering, protect the health of the public and environment, and advance comparative medical knowledge. I will practice my profession conscientiously, with dignity, and in keeping with the principles of veterinary medical ethics. I will strive continuously to improve my professional knowledge and competence and to maintain the highest professional and ethical standards for myself and the profession.”

CVMA 2004

Serment vétérinaire
«En tant que membre de la profession de médecin vétérinaire, j’affirme solennellement que je mettrai mes connaissances et mes compétences scientifiques au service de la société. Je m’efforcerai de protéger la santé et le bien-être des animaux, de soulager leurs souffrances, de protéger la santé publique et écologique et de travailler à l’avancement des connaissances médicales comparées. J’exercerai ma profession consciencieusement, avec dignité et conformément aux principes de déontologie de la médecine vétérinaire. Je m’efforcerai sans cesse d’améliorer mes connaissances et mes compétences professionnelles et de respecter les normes professionnelles et déontologiques les plus rigoureuses à mon égard et à celui de la profession.»

ACMV 2004

The Veterinary Oath states “I will practice my profession conscientiously, with dignity, and in keeping with the principles of veterinary medical ethics.” Did you know that up until recently the CVMA did not have a document outlining these principles of veterinary medical ethics? The fact that Canada did not have an updated Code of Ethics to reference was a concern for the CVMA Council so it worked to update and approve a new veterinary code of ethics document. The new document is called “Principles of Veterinary Medical Ethics of the CVMA.” I would like to highlight some of the important changes within the new document and discuss some of the interesting history in developing our new Principles of Veterinary Medical Ethics.

During the developmental research, a 1955 copy of the Bylaws and Code of Ethics of the CVMA was found. It can be assumed that at some point after 1955, the Association Bylaws were updated and the Code of Ethics was removed and not replaced. This left us as the only national veterinary association without a Code of Ethics. In this 1955 document it

Le Serment vétérinaire stipule : «J’exercerai ma profession consciencieusement, avec dignité et conformément aux principes de déontologie de la médecine vétérinaire.» Saviez-vous que, jusqu’à récemment, l’ACMV ne possédait pas de document stipulant ces principes de déontologie médicale vétérinaire? Le fait que le Canada ne possédait pas de code de déontologie de référence préoccupait le Conseil de l’ACMV et il a donc travaillé afin de réviser et d’approuver un nouveau code de déontologie vétérinaire. Le nouveau document s’intitule «Principes de déontologie médicale vétérinaire de l’ACMV». J’aimerais souligner quelques-uns des changements importants qui ont été apportés au sein du document et présenter l’historique de la mise au point de notre nouveau Code de déontologie médicale vétérinaire.

Pendant la recherche préliminaire, un exemplaire du Règlement administratif et du Code de déontologie de l’ACMV datant de 1955 ont été mis au jour. Nous pouvons prêmer que, à un moment donné après 1955, le Règlement administratif

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stated that all veterinarians must conduct themselves as gentlemen; it was obvious that the document needed an update. It was so outdated a new document had to be developed from scratch. Dr. Barb Horney and I researched the American, British, and Australian Veterinary Medical Associations’ and the Federation of Veterinarians of Europe current Codes of Veterinary Ethics documents; not surprisingly all of those associations’ principles are similar.

The new Principles of Veterinary Medical Ethics is laid out according to general principles, veterinary responsibilities to animals, clients, the public, the veterinary team, and finally to the veterinarians themselves. Historically, the CVMA and the American Veterinary Medical Association (AVMA) Code of Ethics have been similar throughout the development of the associations. In fact, the AVMA Code was worded and organized similar to our 1955 Code, which predated the AVMA code. Clearly, our 2 associations have a long history of collaboration and sharing. The AVMA just recently updated their Code and included an important clause about discrimination. The CVMA Council has added this clause to our Principles as well. Council is also going to ensure that our Principles are reviewed more often to keep them as current as possible.

It was important for Council to have this document focus on Principles. After consultation with the provincial regulatory bodies it was apparent that we needed to ensure that veterinarians did not confuse these Principles with the Codes of the regulatory authorities of the provinces. Each province has a Code of Conduct within their acts or Bylaws that veterinarians in that province must follow and the regulatory bodies enforce. In updating the Principles (the name was changed to Principles from Code), much of the “regulatory language” was removed and we made sure that the Principles did not conflict with provincial regulatory Codes. The Principles are not enforceable, but may be used as a guide by the provincial regulating bodies. The Canadian Veterinary Oath is also not enforceable, but in my opinion it is more important than any provincial regulation. I strongly believe the profession of veterinary medicine should determine its own ethical standards. The CVMA needed this document. Regardless of enforcement, when anyone asks, “What are the ethical standards of the profession?” we can now say we have a document outlining them.

Those who teach our future veterinarians really need these Principles. Every veterinary student has to learn about ethics and jurisprudence in veterinary school. Educators were encouraging the CVMA to have an updated document. Unfortunately until now when students asked for the Principles the response was Canada doesn’t have any, but here are the AVMA ones. The student population of the Canadian veterinary community will benefit greatly from an updated set of Principles. As the president of the CVMA I have had the privilege of being able to meet many veterinarians, practicing locally, nationally, and globally. I recently attended the white coat ceremony of the University of Calgary Veterinary Medicine class of 2020. The students stood and recited the Veterinary Oath. As indicated above, the Oath of the Association has been updated to ensure that the Code of déontologie a été mis à jour et que le Code de déontologie a été supprimé sans être remplacé, ce qui signifiait que nous étions la seule association nationale de médecins vétérinaires sans un Code de déontologie. Le document de 1955 stipulait que tous les médecins vétérinaires devaient se comporter comme des gentilshommes; il était donc manifeste que ce document nécessitait une mise à jour. Il était d’ailleurs tellement désuet qu’une refonte complète du document s’imposait. La D’Dr Barb Horney et moi-même avons effectué des recherches portant sur les codes de déontologie médicale vétérinaire actuellement en vigueur dans les associations de médecins vétérinaires des États-Unis, de la Grande-Bretagne et de l’Australie ainsi que celui de la Fédération des médecins vétérinaires d’Europe et nous avons constaté sans grande surprise que les principes de ces associations étaient passablement semblables.


Il était important pour le Conseil que ce document insiste sur les principes. Après la tenue d’une consultation avec les organismes de réglementation provinciaux, nous avons aussi jugé qu’il était important de faire en sorte qu’il n’y ait aucune confusion entre les principes et les codes des autorités de réglementation des provinces. Chaque province possède un Code de conduite enchâssé dans sa loi ou son règlement administratif que doivent respecter les médecins vétérinaires de cette province et qui doit être appliqué par les organismes de réglementation. Dans la mise à jour des Principes (le nom a été changé de Code à Principes), une bonne part du «langage réglementaire» a été supprimée et nous avons veillé à ce qu’il n’y ait pas de conflit entre les Principes et les Codes réglementaires des provinces. Les Principes ne sont pas exécutoires, mais ils peuvent servir de guide pour les organismes de réglementation provinciaux. Le Serment vétérinaire canadien n’est pas non plus exécutoire, mais, selon moi, il est plus important que tout règlement provincial. J’ai la ferme conviction que la profession de médecin vétérinaire devrait déterminer ses propres normes déontologiques. L’ACMV avait besoin de ce document. Mise à part la question de la nature exécutoire, lorsqu’une personne pose la question «Quelles sont les normes déontologiques de la profession?», nous
states that a veterinarian in Canada will follow the principles of veterinary medical ethics. The ironic issue being that the old Code of Ethics was almost laughable. The veterinary schools of Canada needed a document that they could present to students as a guide to their practice. They can now recite our Oath knowing what is meant by veterinary medical ethics.

The new set of Principles brings a much needed guide to veterinarians of Canada; new, old, and future veterinarians. I would like to acknowledge the hard work by Dr. Barb Horney for getting these Principles finalized and by Dr. Jack Wilson for adding important content and pressuring us to get the job done. The new Principles of Veterinary Medical Ethics of the CVMA will be available to members this fall; an announcement will be made within The CVJ. Please stay tuned.

Troy Bourque
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Ethical question of the month — November 2016

A veterinarian who recently joined your 4-person small animal practice is engaged in a discussion with a long-time client over euthanizing her 16-year-old cat. The cat has been losing weight (although the owner reports a normal appetite) over the last several months due to kidney failure. The cat responded moderately well to the interventions applied but is not expected to recover. Your new colleague believes it is time to euthanize the cat. The owner wishes to give the cat more time. The veterinarian emphasizes his responsibility to avoid unnecessary suffering and mentions his professional obligation to call in the humane society in cases in which owners allow their pets to suffer unnecessarily. The owner is shocked that the veterinarian would accuse her of treating her long-time companion inhumanely. She is certain that after 16 years with this animal that she is a better judge of its comfort and well-being than a veterinarian who has spent 15 minutes examining the cat and associated lab reports. You feel that you should intervene. **How should you respond?**

Submitted by Linda Chow, Ottawa, Ontario

Responses to the case presented are welcome. Please limit your reply to approximately 50 words and forward along with your name and address to: Ethical Choices, c/o Dr. Tim Blackwell, 6486 E. Garafraxa, 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 — August 2016

A good friend and strong animal advocate who works at the local animal shelter contacts you for your professional opinion. A middle-aged cross-bred dog that has been at the shelter for several weeks has been treated symptomatically on two occasions by the shelter veterinarian for anorexia and dehydration. On both occasions the dog improved following treatment with analgesics, vitamins, and intravenous fluids. The dog is considered very “adoptable” but interested parties have been warned that the dog may need “extra care.” Recently an interested couple was told that the dog may need some extra veterinary attention but that if they did not adopt the dog, it likely would be euthanized. The couple agreed to the adoption but two days later the dog was found dead in the kennel. A postmortem examination revealed lymphoma. Your friend would like you to offer your professional opinion on the handling of this case. You appreciate all the good work that these shelters do and you know that the shelter veterinarian discounts her services to help support the shelter. How should you respond?

Question de déontologie du mois — Août 2016

Un bon ami et ardent défenseur des animaux qui travaille au refuge d’animaux local vous contacte pour obtenir votre opinion professionnelle. Un chien de race croisée et d’âge moyen qui est au refuge depuis plusieurs semaines a été traité à deux reprises par la vétérinaire du refuge pour cause d’anorexie et de déshydratation. Au cours des deux occasions, le chien s’est amélioré après le traitement analgésique, des vitamines et des solutions intraveineuses. Le chien est considéré comme très “adoptable”, mais les parties intéressées ont été informées que le chien pourrait nécessiter des «soins supplémentaires». On a récemment dit à un couple intéressé que le chien pourrait avoir besoin de soins vétérinaires supplémentaires, mais que s’ils ne l’adoptaient pas, il serait probablement euthanasié. Le couple a accepté l’adoption, mais deux jours plus tard, le chien a été trouvé mort dans le chenil. Un lymphome a ensuite été découvert à l’autopsie. Votre ami aimerait connaître votre opinion professionnelle relativement à la gestion de ce cas. Vous appréciez l’excellent travail réalisé dans ces refuges et vous savez que la vétérinaire offre ses services à rabais pour appuyer le refuge. Comment devriez-vous répondre?

A shelter veterinarian missing a tumor in a dog — A comment

The dog was destined to die or to be kept alive at great expense both to the shelter and to the dog. This is a case of something being sad, but without negligence. Shelters seek to make things better, not to make things perfect.

Gerald Goeree, DVM, MSc.

An ethicist’s commentary on a shelter veterinarian missing a tumor in a dog

The average citizen does not appreciate the extent to which animal shelters do society’s dirty work. While they are not killing as many unwanted animals as they were 30 years ago, they are still killing far too many. And shelter workers are experiencing massive amounts of “moral stress” based on the deplorable fact that though they go into humane work to help animals, and all too often they end up killing them. Just this morning, this atrocious state of affairs was brought home to me anew. As I entered the varsity weight room to do a workout, I noticed a beautiful shepherd-collie cross lying quietly in a corner. I approached the dog and was met by one of our athletes. “I just adopted him from the shelter,” he said. “He is 13 years old! His owners turned him in.” After complimenting him for being willing to adopt such an elderly animal, I once again found myself trying to imagine what kind of people would surrender a 13-year-old dog, an action that is equivalent to a death sentence save for the kindness of this extraordinary young man.

Early on in my career as an animal advocate, I learned to develop a considerable sense of empathy for those grossly underpaid people who work in shelters. In addition to the moral stress that they experience that ramifies in psychosomatic illness, substance abuse, marital difficulties, nightmares and other psychological problems, they are often vilified by society as “dog killers.” The same holds true for animal control officers, who wish nothing more than that their job become obsolete. And we are obliged to extend a similar degree of empathy to shelter veterinarians such as the one described in this case who provides some level of care to the animals in the shelter.

It is perhaps easy to fault the veterinarian in this case. After all, is not palpation of lymph nodes a basic part of a physical examination? And would not palpation of enlarged lymph nodes serve as a sign of potential lymphoma, at least demanding further diagnosis? On the other hand, how many shelter animals is this veterinarian responsible for? The number could easily be 1000. Surely several hundred! And how often can the veterinarian do a full-blown physical examination? Truly any veterinarian volunteering in such a situation is being set up for failure!

What then is the solution? Any jurisdiction capable of sustaining a shelter probably has a goodly number of veterinarians. If each veterinarian were to volunteer one day each month at
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the shelter checking the animals, much more comprehensive and better medicine could be done, and such thing as a lymphoma is less likely to be missed. If the community is a large one, a fundraiser could be held to acquire funding for a full-time veterinarian. If there is a veterinary school nearby, student volunteers can help to fill the lacuna in veterinary care. The key point is that the shelter is entitled to sufficient veterinary care to keep the animals healthy. If, as veterinarians have often claimed, they are the voice of animal welfare in society, they have a moral obligation to help assure that living things that society has treated like garbage enjoy at least minimally adequate healthcare. By so doing, they can help make society conscious of the moral travesty that shelters exist to address. It is necessary to create an ethos in society that attaches significant shame and opprobrium to relinquishing animals for trivial reasons, such as the dog no longer matches the color scheme, or it is too old to jog with me. (Unfortunately, these are real examples I have heard from shelter workers.)

Bernard E. Rollin, PhD
1. Which of the following is the most likely diagnosis for a horse that is gasping, with its neck outstretched and evidence of ptyalism?
   A. Colic
   B. Equine gastric ulcer syndrome
   C. Choke
   D. Peritonitis
   E. Thromboembolism

2. An easily accessible artery for catheterization and monitoring of blood pressure in cattle is which of the following?
   A. Carotid artery
   B. Lateral metatarsal artery
   C. Facial artery
   D. Auricular artery

3. An adult female cocker spaniel is presented for extremely scaly skin and moderate pruritus. Examination reveals greasy skin with abundant scale and malodor. Large mites are found with 4 pairs of legs and prominent mouthparts. Which of the following is NOT a potential source of infestation?
   A. Humans
   B. Dog
   C. Guinea pig
   D. Cat
   E. Rabbit

4. Which of the following is/are positive signs of successful placement of an epidural needle?
   1. Aspiration of a clear fluid
   2. Moderate resistance to injection of saline
   3. The "hanging drop" being sucked into the needle
   4. Some crepitus being palpated after injection of a small amount of air
   A. 1 is correct.
   B. 1, 3, and 4 are correct.
   C. 2, 3, and 4 are correct.
   D. 3 is correct.

1. Chez un cheval qui présente une respiration haletante, a le cou en extension et manifeste des signes de ptyalisme, lequel des diagnostics suivants est le plus probable?
   A. coliques;
   B. syndrome d’ulcère gastrique du cheval;
   C. obstruction de l’œsophage;
   D. péritonite;
   E. thromboembolie.

2. Laquelle des artères suivantes est facilement accessible pour le cathétérisme et la prise de pression sanguine chez les bœufs?
   A. artère carotide;
   B. artère métatarsienne latérale;
   C. artère faciale;
   D. artère auriculaire.

3. Une chienne Épagneul cocker adulte possède une peau extrêmement écailleuse et manifeste du prurit modéré. L’examen révèle une peau graisseuse avec des squames abondantes et une mauvaise odeur. On observe de gros acariens avec 4 paires de membres et des pièces buccales proéminentes. Lequel des choix suivants n’est pas une source potentielle d’infestation?
   A. humain;
   B. chien;
   C. cobaye;
   D. chat;
   E. lapin.
5. A 3-year-old Portuguese water dog has episodic lethargy, weakness, and diarrhea. The following results are obtained from an ACTH response test: baseline cortisol, 86 nmol/L (reference range: 15 to 110 nmol/L), and post-ACTH cortisol, 320 nmol/L (reference range: 220 to 550 nmol/L). Which of the following is the most likely diagnosis?

A. Hypoadrenocorticism  
B. Hyperadrenocorticism  
C. Normal adrenal function; clinical signs are due to a non-adrenal illness  
D. A glucocorticoid-producing adrenal tumor  
E. A sex-steroid-secreting adrenal tumor

4. Lequel (lesquels) des énoncés suivants est (sont) un signe positif de la réussite de la bonne position d’une aiguille épidurale?

1. L’aspiration d’un liquide clair.  
2. La résistance modérée à l’injection de saline.  
3. Une «goutte en suspension» est aspirée dans l’aiguille.  
4. Certains crépitements sont palpables après l’injection d’une petite quantité d’air.  
   A. 1 est correct;  
   B. 1, 3 et 4 sont corrects;  
   C. 2, 3 et 4 sont corrects;  
   D. 3 est correct.

5. Un Chien d’eau portugais âgé de 3 ans souffre de léthargie épisodique, de faiblesse et de diarrhée. Les résultats suivants proviennent d’un test de réponse à l’ACTH : cortisol initial de base, 86 nmol/L (étendue de référence : 15 à 110 nmol/L) et cortisol post ACTH, 320 nmol/L (étendue de référence : 220 à 550 nmol/L). Lequel des diagnostics suivants est le plus probable?

A. l’hypoadrénocorticisme;  
B. l’hyperadrénocorticisme;  
C. la fonction surrénalienne est normale, les signes cliniques sont dus à une maladie non surrénalienne;  
D. la tumeur surrénalienne produisant des glucocorticoïdes;  
E. la tumeur surrénalienne sécrétant des stéroïdes sexuels.

(See p. 1184 for answers./Voir les réponses à la page 1184.)
First Annual One Health Day Takes Place on November 3, 2016
Promoting Efforts Around the World to Bring Together All Human, Animal and Environmental Health Disciplines

La première Journée annuelle d'Une seule santé a lieu le 3 novembre 2016
Promouvoir les efforts concertés pour réunir les disciplines de la santé humaine, animale et environnementale partout dans le monde

The Canadian Veterinary Medical Association (CVMA) is pleased to help promote the first annual One Health Day on November 3, 2016.

The goal of One Health Day is to raise awareness of the One Health approach for managing complex health problems involving people, animals and the environment. In as many countries as possible, activities and events will give scientists, medical and veterinary practitioners, educators and advocates a powerful, unified voice for moving beyond current regional approaches to emerging infectious diseases, food safety and security, antimicrobial resistance, invasive species, environmental pollution, loss of biodiversity, and many other health challenges.

The CVMA strongly supports the involvement of veterinarians in One Health as they have a unique responsibility for improving the health and welfare of the animals they treat in a manner that also protects and supports human health and a healthy environment. The One Health approach is particularly relevant to the development of collaborative strategies for prudent antimicrobial use and its relation to the control of antimicrobial resistance. The CVMA recognizes that the emergence of antimicrobial resistance is a global concern. It holds that the human health, veterinary, agricultural, and regulatory communities must work co-operatively to minimize the emergence and continued spread of antimicrobial resistance.

Recently, the importance of One Health was emphasized during the CVMA’s 2016 Animal Health Week campaign that ran from October 2 to 8, 2016. Under the slogan, Animal Health + Human Health + Planet Health = One Health, it reminded animal owners that managing the health of their animals not only protects their animals, but ensures the health of humans and the environment as well.

For more information on One Health Day, visit the One Health Commission’s website (www.onehealthcommission.org).
The Importance of Veterinarian Wellness

Resources to Help Manage your Physical, Mental and Emotional Well-Being

In the veterinary profession, stress and the danger of long-term exhaustion are significant, and the risk of suicide among veterinarians is disturbing. Whether you are a student, faculty member, practice owner, practice manager or associate veterinarian, the long hours, heavy workload, and poor work-life balance threaten the health and well-being of veterinary professionals. There has been a wealth of discussion on the topic of wellness in veterinary medicine over the past few years and it is important that this issue be kept at the forefront.

How can the Canadian Veterinary Medical Association (CVMA) help? The CVMA wellness advisory group has looked at ways to complement wellness programs and resources that are currently available to Canadian veterinarians and veterinary students. A new section of the CVMA website was created to provide easy access to pertinent resources and information from numerous sources to help support the personal and professional well-being of veterinarians and veterinary students, with a focus on emotional and mental health, physical health, and veterinarian wellness. Additional resources will continue to be added as they are identified.

To access these resources, click on the ‘Health and Wellness of Veterinarians’ rotating banner on the CVMA homepage (www.canadianveterinarians.net) or click on the Practice & Economics tab and follow the link to the ‘Veterinarian Health and Wellness Resources.’

The CVMA also offers a mentoring program and Web resources to support the early career DVMs.

CVMA Practice Diagnostic Report: Evidence-Based Management

Rapport diagnostique de la pratique de l’ACMV : une gestion fondée sur des données probantes

Advances in technology and communication have made cutting-edge laboratory testing ubiquitous in veterinary hospitals across North America. The availability and affordability of both in-house lab equipment and referral labs have helped to level the playing field between smaller single-doctor practices and large multi-doctor referral hospitals. The result is a healthier pet population through better evidence-based medicine.

Les progrès dans le domaine de la technologie et des communications ont rendu désuètes les analyses des laboratoires de pointe pour les cliniques vétérinaires de l’Amérique du Nord. La disponibilité et l’affordabilité de l’équipement de laboratoire interne et des laboratoires spécialisés ont contribué à la création de règles du jeu équitables entre les pratiques à un médecin vétérinaire et les grandes cliniques spécialisées comptant plusieurs vétérinaires.
The Canadian Veterinary Medical Association (CVMA) Practice Diagnostic Report extends this opportunity to financial matters. Increased availability of financial benchmarks provided in the Practice Diagnostic Report can help improve the economic health of individual practices and the veterinary profession. CVMA members who complete the Practice Owners Economic Survey have access to complimentary benchmarking on revenue, expenses, hours worked, fees, and staff. The report calculates their financial metrics and compares them to the average and top performing hospitals in their provinces. New in 2016, the Practice Diagnostic Report compares year over year trends for individual hospitals that have submitted 2 consecutive years of data.

Successful managers know that evidence-based management is essential to the financial success of the practice; measure, manage, and measure again to track the improvement. The CVMA Practice Diagnostic Report is the quintessential tool that can help veterinarians measure and manage their practice.

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

Revenue mix is another important benchmark for practices to measure the effectiveness of their efforts to promote nutrition. For example, if a hospital prides itself on nutrition, they could expect to see diet sales contributing a higher than average share of revenue. If, according to their Practice Diagnostic Report, their diet sales contribute less than the benchmark, they have some work to do.

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

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

Le résultat est une population d’animaux de compagnie en meilleure santé grâce à une médecine fondée sur des données probantes.

Le Rapport diagnostique de la pratique de l’ACMV offre maintenant la possibilité de réaliser des analyses de pointe dans le domaine des questions financières. La disponibilité accrue des données de référence financières fournies dans le Rapport diagnostique de la pratique peut contribuer à l’amélioration de la santé financière des pratiques individuelles et de la profession vétérinaire. Les membres de l’ACMV qui remplissent le Sondage économique auprès des propriétaires de pratique ont accès à une analyse comparative gratuite des recettes, des dépenses, des heures travaillées, des tarifs et des employés. Le rapport calcule les paramètres financiers et les compare aux cliniques moyennes et à celles ayant un rendement supérieur dans la province. Pour la première fois en 2016, le Rapport diagnostique de la pratique compare les tendances d’une année à l’autre pour les cliniques individuelles qui ont soumis des données pendant plus de deux années consécutives.

Les bons gestionnaires savent qu’une gestion fondée sur des données probantes est essentielle pour assurer le succès financier de la pratique : il faut mesurer, gérer et mesurer de nouveau afin d’effectuer un suivi des progrès. Le Rapport diagnostique de la pratique de l’ACMV représente l’outil par excellence pour aider les vétérinaires à mesurer et à gérer leur pratique.

Données sur le chiffre d’affaires
Lorsqu’il est considéré en isolation, le chiffre d’affaires annuel ou mensuel présente des applications limitées. La comparaison du même mois de cette année avec celui de l’année précédente peut indiquer une croissance, mais sans données de référence, les vétérinaires ne savent pas comment la croissance du revenu se compare à celle de leurs collègues. Par exemple, vous pourriez connaître une croissance de 5 % du chiffre d’affaires, un résultat excellent selon vous, jusqu’à ce que vous constatiez que, dans votre province, la pratique moyenne a connu une hausse de 10 % pendant la même période. Parallèlement, votre chiffre d’affaires annuel a pu atteindre le million de dollars l’an dernier, mais lorsque vous apprenez que la clinique moyenne a fait un chiffre d’affaires de 1,5 million avec le même nombre de vétérinaires, vous constatez alors qu’il y a encore lieu d’améliorer les choses.

La répartition des recettes est une autre donnée de référence qui aide les pratiques à mesurer l’efficacité de leurs efforts pour promouvoir la nutrition. Par exemple, si une clinique accorde une grande importance à la nutrition, elle pourrait s’attendre à ce que la vente d’aliments représente une plus grande proportion des recettes. Si, selon le Rapport diagnostique de la pratique, la vente d’aliments s’établit à moins de 50 % de la donnée de référence, alors il y a du travail à réaliser.

Données sur les clients
Le Rapport diagnostique de la pratique fournit des données de référence sur le nombre de clients par vétérinaire, les recettes par client, les visites par client par année et, pour les pratiques
examining the number of staff per doctor as well staff wages as a percentage of gross revenue. If staff wages as a percentage of gross revenue are higher than average, the staff strategy may not be working and the practice owner can look to the staff per doctor benchmarks to fine tune or develop an entirely new staff strategy.

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

**Fees**
One of the most important determinants in revenues is veterinary fees. The Practice Diagnostic Report shows veterinarians how their fees compare to the average and the fee guide for each province. A year-over-year comparison is also provided along with an analysis that shows how incomes could improve if fees were increased.

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

**Value-added benefit**
CVMA members who complete the Practice Owners Economic Survey can take advantage of this value-added individual Practice Diagnostic Report and Practice Value Estimate.

To receive this free confidential report after completing the survey, a copy of your latest financial statements for the past 12-months (either an accounting statement or an internal statement of expenditures breakdown) must be provided for analysis. To ensure confidentiality, you will be required to send your financials directly to the CVMA Business Management Program service provider with direction as to whether you prefer to receive your customized report by e-mail or mail.

One of the prime objectives of the CVMA Business Management Program is to help veterinarians achieve “A Successful Career and a Balanced Life.” The achievement of this state of balance may be more easily attainable in profitable practices and, like a report card, the Practice Value Estimate is an overall grade for the financial success of your practice.

*This article is provided as part of the CVMA Business Management Program, which is co-sponsored by Idexx Laboratories, Merck Animal Health, Petsecure-Canada’s Pet Insurance, and Scotiabank.*

(by Darren Osborne, Director of Economic Research, Ontario Veterinary Medical Association)

who provide the data constantes sur les clients pendant deux années consécutives, la rétention des clients. Les données de référence sur les clients peuvent servir à fixer des objectifs de production et à effectuer un suivi. Par exemple, les pratiques qui ont moins de clients par vétérinaire doivent afficher des recettes supérieures par client pour atteindre les objectifs de revenu et elles peuvent s’attendre à ce qu’un nombre supérieur de visites produise des ventes supérieures à la moyenne.

**Données sur les employés**
Il n’y a pas de «bonne façon» d’embaucher les employés d’une clinique vétérinaire. Certaines obtiennent du succès avec un rythme plus lent et moins d’employés par vétérinaire, tandis que d’autres prospèrent avec un nombre supérieur d’employés par vétérinaire. Le Rapport diagnostique de la pratique peut indiquer si une stratégie de gestion des ressources humaines fonctionne bien en examinant le nombre d’employés par médecin ainsi que les salaires des employés en tant que pourcentage du chiffre d’affaires brut. Si les salaires des employés en tant que pourcentage du chiffre d’affaires brut sont supérieurs à la moyenne, il est alors possible que la stratégie de dotation des employés ne soit pas efficace et le propriétaire de pratique pourra consulter les données de référence sur les employés par médecin vétérinaire pour ajuster sa gestion du personnel ou concevoir une toute nouvelle stratégie en matière de ressources humaines.

**Dépenses en tant que pourcentage du chiffre d’affaires brut**
L’un des piliers du Rapport diagnostique de la pratique est l’analyse des dépenses. Les dépenses en tant que pourcentage du chiffre d’affaires brut sont comparées à la moyenne des dépenses et à l’année précédente afin de souligner des domaines qui peuvent présenter des économies potentielles à l’aide d’un meilleur contrôle des dépenses. Beaucoup de propriétaires de pratique ont signalé qu’ils avaient annulé les pages jaunes et réduit le coût des fournitures de bureau tout en commençant à mieux gérer leur stock une fois qu’ils avaient constaté que leurs dépenses étaient supérieures à la normale.

**Tarifs**
Les tarifs vétérinaires représentent l’un des déterminants les plus importants du chiffre d’affaires. Le Rapport diagnostique de la pratique montre aux vétérinaires comment leurs tarifs se comparent à la moyenne et au guide tarifaire dans chaque province. Une comparaison d’une année à l’autre est aussi fournie avec une analyse qui indique comment le bénéfice pourrait être amélioré s’il se produisait une hausse des tarifs.

**Estimation de la valeur d’une pratique**
En se fondant sur les renseignements contenus dans le Sondage économique auprès des propriétaires de pratique et les états financiers, l’estimation de la valeur d’une pratique fournit une estimation de la valeur d’une pratique en se basant sur l’encaisse. Présentée sous forme de pourcentage du chiffre d’affaires brut, l’estimation de la valeur d’une pratique comprend le chiffre d’affaires, les dépenses et la production vétérinaire. Certains vétérinaires considèrent ce chiffre comme une évaluation financière annuelle. Si l’estimation de la valeur de la pratique a augmenté, alors la pratique se trouve en meilleure position financière que l’année précédente.
CVMA Updates its Code of Ethics to Principles of Veterinary Medical Ethics

L’ACMV met à jour son Code de déontologie qui s’intitule maintenant Principes de déontologie médicale vétérinaire

Since 1955, the Canadian Veterinary Medical Association (CVMA) has had a “Code of Ethics” as part of its Constitution and Bylaws. In collaboration with Dr. Barbara Horney, Dr. Troy Bourque, president of the CVMA, initiated an update of the Code and drafted a more extensive document entitled Principles of Veterinary Medical Ethics of the CVMA.

While the primary professional responsibility of veterinarians is to their patients, they must balance this with responsibilities they also hold to their clients, to the public, to the profession, to their colleagues, and to themselves. The updated document is designed to be easy to understand, remember, and use when veterinarians are working through an ethical dilemma.

The title change to Principles of Veterinary Medical Ethics of the CVMA reflects the role of the CVMA to develop national guidelines for veterinary medical ethics and differentiate them from the legislative Codes set by the provinces and territories for the veterinary profession. Professional veterinary associations and regulatory bodies may adopt or create a similar document as a guide for their activities.

Colleges of veterinary medicine should stress the teaching of ethical and value issues as part of the professional curriculum for all veterinary students. The CVMA encourages the National Board of Veterinary Medical Examiners to prepare and include questions regarding professional ethics in the North American Veterinary Licensing Examination (NAVLE). The CVMA will review these principles periodically to ensure that they remain complete and current.

You may view the full document on the CVMA’s website (www.canadianveterinarians.net), under the About CVMA tab.

L’un des objectifs prioritaires du Programme de gestion commerciale de l’ACMV est d’aider les médecins vétérinaires à «mener une carrière réussie et une vie équilibrée». L’efficacité travail-vie personnelle est sans aucun doute plus facile à réaliser lorsque l’entreprise vétérinaire est rentable et, comme un bulletin de rendement, l’estimation de la valeur de la pratique est une note globale de la réussite financière de votre établissement.

Le présent article est rédigé dans le cadre du Programme de gestion commerciale de l’ACMV, qui est cocommandité par la Banque Scotia, Idexx Laboratories, Merck Santé Animale et Petsecure-l’assurance canadienne pour animaux de compagnie.

(par Darren Osborne, directeur de la recherche économique, l’Ontario Veterinary Medical Association)
2017 CVMA Awards
Nominations Are Open!

Each year, through its awards program, the Canadian Veterinary Medical Association (CVMA) proudly recognizes individuals who have demonstrated significant accomplishments, exemplary leadership and tireless commitment to Canada’s veterinary community. Nominations for the 2017 CVMA Awards are being accepted from now until January 31, 2017.

Award eligibility
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. We invite you to consider nominating a deserving colleague for one of the following CVMA’s prestigious awards:

CVMA Humane Award
Established by the CVMA in 1986, and sponsored by Merck Animal Health, this award recognizes leadership in the care and well-being of animals. The award, which consists of $1000 and a plaque, is presented to a CVMA member whose work is judged to have contributed significantly to the welfare and well-being of animals.

CVMA Industry Award
Instituted in 1996, the CVMA Industry Award publicly acknowledges and celebrates the role of industry in veterinary medicine. The award formally recognizes a CVMA member for their contributions to the advancement of veterinary medicine.

Merck Veterinary Award
Established in 1985, and sponsored by Merck Animal Health, this award is presented to a CVMA member whose work in food animal production practice, clinical research, or basic sciences is judged to have contributed significantly to the advancement of food animal medicine and surgery, including heard health management. The award consists of $1000 and a plaque.

Small Animal Practitioner Award
Sponsored by Petsecure Pet Health Insurance, this award is presented to a CVMA member whose work in small animal practice,

Prix de l’ACMV 2017
Ouverture des mises en candidature!

Chaque année, dans le cadre de son programme de prix, l’Association canadienne des médecins vétérinaires (ACMV) reconnaît fièrement des personnes qui ont accompli des réalisations exceptionnelles et ont fait preuve d’un leadership exemplaire ainsi que d’un dévouement infatigable envers la collectivité vétérinaire du Canada. Les mises en candidature pour les Prix de l’ACMV 2017 seront acceptées jusqu’au 31 janvier 2017.

Admissibilité aux prix
Les personnes mises en candidature (sauf celles mises en candidature pour le titre de membre honoraire) doivent être membres en règle de l’ACMV pour être admissibles à la mise en candidature. Cependant, elles peuvent être mises en candidature par des non-membres de l’ACMV. Nous vous invitons à considérer la mise en candidature d’un collègue méritant à l’un des prestigieux prix de l’ACMV suivants :

Prix humanitaire de l’ACMV
Créé par l’ACMV en 1986 et commandité par Merck Santé Animale, ce prix reconnaît le leadership à l’égard du soin et du bien-être des animaux. Le prix, qui comporte une bourse de 1000 $ et une plaque, est décerné à un membre de l’ACMV dont le travail représente une contribution importante au bien-être des animaux.

Prix de l’industrie de l’ACMV

Prix vétérinaire Merck
Établi en 1985 et commandité par Merck Santé Animale, ce prix est décerné à un membre de l’ACMV dont le travail en pratique des animaux destinés à l’alimentation, en recherche clinique ou en sciences fondamentales représente une contribution importante pour l’avancement de la médecine et de la chirurgie des animaux destinés à l’alimentation, y compris la gestion de la santé du troupeau. Le prix comporte une bourse de 1000 $ et une plaque.

Prix du praticien des petits animaux
Commandité par Petsecure assurance maladie pour animaux, ce prix est décerné à un membre de l’ACMV dont le travail en pratique des petits animaux, en recherche clinique ou en sciences fondamentales représente une contribution importante à l’avancement de la médecine ou de la chirurgie des petits animaux ou à la gestion d’une pratique pour petits animaux. Le prix comporte une bourse de 1000 $ et une plaque.

Prix de la pratique de l’année de l’ACMV
Instauré en 2013, le Prix de la pratique de l’année comporte une bourse de 1000 $ et une plaque. Ce prix est commandité par la Banque Scotia, un leader au chapitre des services bancaires pour les professionnels. Le prix reconnaît l’équipe d’une pratique vétérinaire pour des réalisations exceptionnelles dans sa collectivité locale. Ces réalisations peuvent inclure l’innovation dans la prestation de services vétérinaires, l’engagement envers l’équilibre travail-vie, une participation communautaire ou du travail de bienfaisance ou
clinical research or basic sciences is judged to have contributed significantly to the advancement of small animal medicine, surgery, or the management of a small animal practice. The award consists of $1000 and a plaque.

**CVMA Practice of the Year Award**

Established in 2013, the Practice of the Year Award consists of $1000 and a plaque and is sponsored by Scotiabank, a leader in banking services for professionals. The award recognizes a veterinary practice team for outstanding achievement within their local community. Such achievements may include innovations in the provision of veterinary services, commitment to work-life balance, meaningful community or charitable involvement, or implementation of “green” practice procedures.

**CVMA Life Membership**

Life Membership is presented to a CVMA member for long and outstanding service on CVMA Council, Executive, boards and committees or for outstanding contributions to the veterinary profession. The Life Member is presented with a framed certificate and shall be invited to attend meetings of the Association, and shall not be liable to pay dues, but shall enjoy all the rights and privileges of membership.

**CVMA Honorary Membership**

Honorary membership is presented to an individual who has rendered distinguished service to the profession, whether residing in Canada or elsewhere. The Honorary Member does not pay fees and cannot vote at meetings, or hold any elected office in the CVMA.

**Nomination package**

Selection of award recipients is based solely on the information provided in the nomination package. Please follow these steps to ensure all required documents are included with your nomination package:

1. Submit a completed nomination form. A copy of this form is included in this issue of the CVJ. The form is also available for download under the CVMA Awards section of our website (www.canadianveterinarians.net).
2. Include the following supporting documents as part of the nomination package:
   - Outline of nominee’s Key Professional Accomplishments (max. 1000 words)
   - Letters of support (max. of 5 letters; each letter 500 words or less)
   - Newspaper articles (max. of 2 articles written within the last 2 years)
   - Articles written by nominee (max. of 3 web links to articles).

Nomination packages are due by January 31, 2017, 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.

Questions? Please contact Communications at 1-800-567-2862, ext. 125 or visit the CVMA Awards section of the website (www.canadianveterinarians.net).

**Membre à vie de l’ACMV**

Le titre de membre à vie est conféré à un membre de l’ACMV pour un service exceptionnel et de longue date au sein du Conseil, de l’exécutif, des bureaux et des comités de l’ACMV ou pour des contributions exceptionnelles à la profession vétérinaire. Le membre à vie reçoit un certificat encadré et il est invité à assister aux réunions de l’association. Il ne doit pas verser de cotisation mais jouit de tous les droits et privilèges conférés par l’adhésion.

**Membre honorifique de l’ACMV**

Le titre de membre honorifique est conféré à une personne qui a rendu des services distingués à la profession et réside au Canada ou ailleurs. Le membre honorifique ne doit pas verser de cotisation, mais il ne peut pas voter lors des réunions ni occuper un poste élu au sein de l’ACMV.

**Trousse de mise en candidature**

Le choix des récipiendaires de prix se fonde uniquement sur les renseignements fournis dans la trousse de mise en candidature. Veuillez suivre les étapes suivantes afin de garantir l’inclusion des documents requis dans la trousse de mise en candidature :

1. Il faut soumettre un formulaire de mise en candidature rempli. Un exemplaire de ce formulaire est inclus dans le présent numéro de La RVC. Le formulaire peut aussi être téléchargé dans la section des Prix de l’ACMV de notre site Web (www.veterinairesaucanada.net).
2. Inclure tous les documents à l’appui avec la trousse de mise en candidature :
   - Décrire les principales réalisations professionnelles du candidat (max. de 1000 mots)
   - Lettres d’appui (max. de cinq lettres; chaque lettre compte 500 mots ou moins)
   - Coupures de journaux (max. de deux articles écrits au cours des deux dernières années)
   - Articles rédigés par le candidat (max. de 3 liens Web vers les articles)

Les troupes de mise en candidature doivent être soumises d’ici le 31 janvier 2017 par courriel (communications@cvma-acmv.org), par télécopieur au 613-236-9681 ou par la poste au bureau de l’ACMV, 339, rue Booth, Ottawa (Ontario) K1R 7K1.

Canadian Veterinary Reserve Members Annually Renew their Commitment to Emergency Response for Animals!

Les membres de la Réserve vétérinaire canadienne renouvellent annuellement leur engagement envers l’intervention d’urgence pour les animaux!

Over its 10-year history the Canadian Veterinary Reserve (CVR) has maintained its commitment to practice the CVR Emergency Response Call Up Process each year. The CVR Spring 2016 Call Up Drill reconfirmed the commitment of CVR members and the effectiveness of the CVR Emergency Communication process and procedures. CVR members pledged their ongoing interest in the CVR by updating their membership profiles on the CVR’s new membership database. As a result of this updated membership database, the Spring 2016 Call Up Drill resulted in 100% of CVR members being contacted to participate in the drill.

The primary objective of any CVR Call Up Drill is to test the responsiveness of CVR members to an e-mail call up. In the Spring 2016 Call Up Drill our CVR members met or exceeded all expectations as they have also done in every Call Up Drill that the CVR has held in the past 10 years.

CVR Spring 2016 Call Up Results:

<table>
<thead>
<tr>
<th>Objective Set</th>
<th>Results</th>
<th>Objective met?</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% of CVR members receive CVR Call Up e-mail</td>
<td>100% of members received the e-mail. No rejected e-mails resulted</td>
<td>Yes</td>
</tr>
<tr>
<td>50% of those receiving the e-mail reply to it</td>
<td>78% response rate</td>
<td>Exceeded</td>
</tr>
<tr>
<td>Of those responding, at least 50% are YES — available to serve</td>
<td>62% of respondents were available to serve (a further 10% were partially available)</td>
<td>Exceeded</td>
</tr>
<tr>
<td>Response turnaround time — at least 50% of all responses are received within 24 hours of call up notice being sent</td>
<td>39% of responses were received within first 4 hours. 86% of responses within 24 hours</td>
<td>Exceeded</td>
</tr>
</tbody>
</table>

CVR management and CVR members expressed a high degree of satisfaction with the Call Up communication process and the results. The CVR Advisory Board has indicated that these response rates are high in comparison to similar volunteer reserves in North America.

CVR members are all volunteer veterinarians who may choose to serve or not based on their availability at the time of Call Up. All members who are deployed for service receive appropriate communication and procedures. CVR members pledged their ongoing interest in the CVR by updating their membership profiles on the CVR’s new membership database. As a result of this updated membership database, the Spring 2016 Call Up Drill resulted in 100% of CVR members being contacted to participate in the drill.

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La direction de la RVC et les membres de la RVC ont exprimé un haut niveau de satisfaction à l’égard du processus de communication pour la mobilisation ainsi que des résultats. Le Conseil consultatif de la RVC a indiqué que ces taux de réponse sont élevés comparativement à des réserves bénévoles semblables en Amérique du Nord.

Les membres de la RVC sont tous des vétérinaires bénévoles qui peuvent choisir de participer à une affectation selon leur disponibilité au moment de leur mobilisation. Tous les membres qui sont déployés pour une mobilisation reçoivent une formation appropriée en fonction de l’intervention et ils sont rémunérés pour leurs services.
training specific to the disaster response and are remunerated for their service.

CVR is growing its membership base in 2016! All veterinarians in Canada are eligible for membership. Please apply at (www.canadianveterinarians.net/science-knowledge/becoming-member).

The CVR is a program of the Canadian Veterinary Medical Association. Membership in the CVR is open to all veterinarians in Canada.

Are You Taking Full Advantage of Your CVMA Membership?

Your Canadian Veterinary Medical Association (CVMA) membership entitles you to privileges that help you achieve professional, personal, and financial success. As your national veterinary medical association, representing over 11 000 Canadian veterinarians, the CVMA has significant purchasing power and is continually identifying means of providing members with added value by offering exclusive, relevant discounted services to veterinarians and veterinary practices. These savings can more than cover the cost of your annual membership fee. A few of the CVMA’s services offered to members are highlighted below.

The Canadian Veterinary Journal’s Online Classified Advertising

The Canadian Veterinary Journal’s (The CVJ) online classified advertising is a web-based tool enabling you to submit electronic advertisements for posting in The CVJ’s classified section. You can also browse and search through current ads. The advertisement rates are determined by the ad’s character count and the full insertion rate is automatically calculated. CVMA members save 50% on ad placement rates. The CVJ’s online classified advertising is the go-to place if you’re looking to hire a veterinarian, locum or technician, sell or purchase a practice or veterinary equipment anywhere in Canada.

Staples Advantage

Staples Advantage, the business-to-business division of Staples, is Canada’s largest business supplier of competitively priced office products including supplies, technology, furniture, and business services. The CVMA negotiated a group purchasing agreement exclusively for its members that gives you advantageous discounts on your office supply products. Contact the CVMA to obtain an application form.

CVMA Petro-Canada SuperPass™ Program

The CVMA Petro-Canada SuperPass™ credit card program provides CVMA members with fuel and service discounts. The program also provides a customized online account management service to help you manage and control expenses. With this

La RVC désire augmenter son effectif en 2016! Tous les vétérinaires au Canada sont admissibles à l’adhésion. Veuillez présenter une demande au (www.veterinairesaucanada.net/science-knowledge/becoming-member).

La RVC est un programme de l’Association canadienne des médecins vétérinaires. L’adhésion à la RVC est ouverte à tous les médecins vétérinaires du Canada.

Profitez-vous pleinement de votre adhésion à l’ACMV?

Votre adhésion à l’Association canadienne des médecins vétérinaires (ACMV) vous donne accès à des privilèges qui appuient votre succès professionnel, personnel et financier. En tant que votre association nationale de médecins vétérinaires, qui représente plus de 11 000 vétérinaires canadiens, l’ACMV possède un pouvoir d’achat important et elle identifie continuellement des moyens visant à offrir aux membres une valeur ajoutée grâce à des services à rabais exclusifs et pertinents pour les vétérinaires et les pratiques vétérinaires. Ces économies peuvent représenter un montant supérieur au coût de votre cotisation annuelle. Quelques-uns des services de l’ACMV offerts aux membres sont présentés ci-dessous.

Petites annonces en ligne de La Revue vétérinaire canadienne

Les petites annonces en ligne de La Revue vétérinaire canadienne (La RVC) sont un outil Web qui vous permet de soumettre des annonces électroniques pour affichage dans la section des petites annonces de La RVC. Vous pouvez aussi consulter les annonces courantes. Les tarifs publicitaires sont déterminés par le nombre de caractères de l’annonce et le taux de publication intégral est automatiquement calculé. Les membres de l’ACMV économisent 50 % sur les tarifs publicitaires. Les petites annonces en ligne de La RVC sont l’endroit où aller pour embaucher un vétérinaire, un remplaçant ou un technicien et acheter ou vendre une pratique ou de l’équipement vétérinaire n’importe où au Canada.

Staples Avantage

Staples Avantage, la division de services aux entreprises de Staples, est le plus important fournisseur de produits de bureaux, dont des fournitures, de la technologie, du mobilier et des services d’affaires, aux entreprises, du Canada. L’ACMV a négocié une entente d’achat de groupe exclusivement pour ses membres qui vous offre des rabais advantageux sur vos fournitures de bureau. Contactez l’ACMV pour obtenir un formulaire de demande.

Programme SuperPassMC de Petro-Canada et de l’ACMV

Le programme de carte de crédit SuperPassMC de Petro-Canada et de l’ACMV offre aux membres de l’ACMV des rabais sur le carburant et les services. Le programme offre aussi un service de gestion en ligne des comptes qui est conçu sur mesure pour vous aider à
Welcome Back Students!

I would like to start by welcoming all 1st-year students into their respective colleges! I hope you have enjoyed your first couple months of vet school, and are ready for the exciting experience that is in store for you. Welcome back to all returning students, I hope that everyone enjoyed their summer and is ready to dive into another academic year.

As veterinary students, we are all members of the Students of the Canadian Veterinary Medical Association (SCVMA), and with that membership come a few benefits that you should know about. Each student receives a CVMA lab coat and a SCVMA name badge in 1st year. Every student also receives a free copy of *The Canadian Veterinary Journal (The CVJ)* each month. In addition, students have access to exclusive veterinary information on the CVMA website, including the Early Career DVM Resource Hub, as well as a number of other benefits. If you have questions about the benefits of being a Student of the CVMA feel free to visit the CVMA page on the CVMA website, or contact the SCVMA representative at your school. The SCVMA Committee is made up of 1 representative from each of the 5 Canadian veterinary schools, with each member serving as president, Symposium coordinator, VetRap Student Newsletter coordinator, New Graduate Survey coordinator, or CVJ editorial coordinator. The president of the SCVMA acts as a liaison between students and the CVMA Council. This year our SCVMA president is Elizabeth Hartnett from the Ontario Veterinary College, and she will attend the CVMA Council meetings to act as a spokesperson for all veterinary students.

The SCVMA organizes a few events throughout the year that I encourage you to attend! Each college will host a “One Voice” card you can save 2.0 cents per litre on all types of gasoline and diesel at any Canadian Petro-Canada location, with a minimum purchase of 400 litres per month and save 20% on Petro-Canada retail service station car washes. Contact the CVMA to obtain an application form.

**ADTEL® Telephone Hold Music and Messages**

ADTEL® ADTEL® Telephone Hold Music and Messages are continuously played audio messages for callers to hear while on hold. The professionally recorded messages are customized for your clinic or selected from CVMA’s pre-written animal health messages. The ADTEL® service is entertaining while effectively delivering your message. ADTEL® offers CVMA members 63% off published rates.

Learn more about your Canadian Veterinary Medical Association member benefits and privileges. Visit the website (www.canadianveterinarians.net), or contact the CVMA at 1-800-567-2862, or e-mail (admin@cvma-acmv.org).

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Bonne rentrée aux étudiants!

J’aimerais commencer en souhaitant la bienvenue à tous les étudiants de première année dans les collèges respectifs! J’espère que vous avez profité des deux premiers mois de l’école de médecine vétérinaire et que vous êtes prêts pour l’expérience emballante qui vous attend. Bonne rentrée à tous les étudiants qui effectuent un retour et j’espère que tout le monde a bien profité de l’été et est prêt à se lancer dans une autre année universitaire.

En tant qu’étudiants en médecine vétérinaire, nous sommes tous membres des Étudiants de l’Association canadienne des médecins vétérinaires (ACMV) et, cette adhésion offre plusieurs avantages que vous devriez connaître. Chaque étudiant recevra un sarrail de l’ACMV et un insigne d’identité de l’ACMV en première année. Tous les étudiants recevront aussi un exemplaire gratuit de *La Revue vétérinaire canadienne* (La RVC) chaque mois. De plus, les étudiants ont accès à des renseignements vétérinaires exclusifs sur le site Web de l’ACMV, y compris le Carrefour des ressources des vétérinaires en début de carrière ainsi que plusieurs autres avantages. Si vous avez des questions à propos des avantages de l’adhésion aux Étudiants de l’ACMV, veuillez visiter la page des ÉACMV sur le site Web de l’ACMV ou contactez le représentant de l’ACMV à votre école. Le Comité des ÉACMV se compose d’un représentant dans chacune des cinq écoles de médecine vétérinaire du Canada et les représentants occupent l’un des postes suivants : président, coordonnateur du Symposium, coordonnateur du bulletin étudiant VetRap, coordonnateur du Sondage auprès des finissants ou coordonnateur éditorial de *La RVC*. Le président des ÉACMV agit à titre d’agent de liaison entre les étudiants et le Conseil de l’ACMV. Cette année, notre présidente des ÉACMV est Elizabeth Hartnett de l’Ontario Veterinary College et elle assistera aux réunions du...
presentation that will be followed by an interactive discussion on a selected “hot topic.” This year the discussion topic will be breed bans. I strongly urge all students to attend these sessions and enjoy the lunch provided by the CVMA. Another important event is the SCVMA Symposium. This year the Symposium will be held at the University of Calgary Faculty of Veterinary Medicine in Calgary, Alberta and is sure to be a fun and educational weekend! The theme is “Take the Bull by the Horns, Take Charge of your Actions” with a focus on large animal medicine and the guest speaker is Dr. Temple Grandin.

On behalf of all veterinary students I would like to thank the CVMA for welcoming us into the profession, extending these benefits to us, and providing us with so many amazing opportunities! Hope everyone is ready to enjoy another year!

(by Traci Henderson, SCVMA Representative, WCVM)

Conseil de l'ACMV pour agir à titre de porte-parole pour tous les étudiants en médecine vétérinaire.

Les ÉACMV organisent des activités pendant l’année et je vous encourage à y assister! Chaque collège organisera la présentation «Une voix» qui sera suivie d'une discussion interactive sur plusieurs sujets “brûlants”. Cette année, le sujet de discussion sera l’interdiction de races spécifiques. J’encourage tous les étudiants à assister à ces ateliers et à profiter du repas du midi offert par l’ACMV. Un autre événement important est le Symposium des ÉACMV. Cette année, le Symposium se tiendra à la Faculté de médecine vétérinaire de l’Université de Calgary, à Calgary, en Alberta, et ce sera à coup sûr une fin de semaine amusante et enrichissante! Le thème est «Prenez le taureau par les cornes, assumez la responsabilité de vos actes» et portera sur la médecine des grands animaux. La conférencière invitée sera la Dr. Temple Grandin.

Au nom de tous les étudiants en médecine vétérinaire, j’aimerais remercier l’ACMV de nous accueillir au sein de la profession, de nous offrir ces avantages et de nous permettre d’avoir accès à ces possibilités extraordinaires! J’espère que tout le monde est prêt à profiter de la nouvelle année d’études!

(par Traci Henderson, représentante des ÉACMV, WCVM)

Have you been checking your e-mail inbox?

The Canadian Veterinary Medical Association (CVMA) communicates time-sensitive and relevant information and news to its members by e-mail based on the addresses we have on record in our database. If you are not receiving e-mail communication from us, it may be that we do not have a valid e-mail address for you.

Review/update your contact information and stay connected!

Also, ensure that you add us (notify@cvma-acmv.org) to your safe sender’s list so that our messages do not get blocked.

Online

Log on at www.canadianveterinarians.net and view your contact information. You can make changes directly online.

Contact CVMA

By e-mail at admin@cvma-acmv.org or by telephone at 1.800.567.2862. We will confirm the e-mail address we currently have for you and make any necessary changes.
Greetings from Alberta! Here are a few highlights of the ABVMA’s activities since our last update and several important items we are currently working on:

**Veterinary Profession Act (VPA) amendments**

Amendments to the VPA, known as Bill 13, were tabled in the Alberta Legislature in May. The results of that bill were not available at the time of this writing. Thanks to the hard work of our ABVMA staff, the Government of Alberta’s professional regulatory group, Legislative Review Committee, and the Alberta Minister of Labour Christina Gray, these amendments would allow registered veterinary technologists in Alberta to be given full representation on the ABVMA’s governance bodies. Registered veterinary technologists will be able to participate in the decision-making process of our Association by being able to vote on Council and legislated committees. The amendments will also ensure the approximately 1500 registered veterinary technologists in the province would comply with the highest professional standards by being accountable through the Association’s complaints and discipline process. The ABVMA is currently working with the Government of Alberta to amend our general regulations to reflect the updated VPA when it comes into force at proclamation.

**Pharmaceutical stewardship**

The ABVMA continues to encourage and promote awareness regarding pharmaceutical stewardship. ABVMA staff members have been key contributors to the professional standards template entitled “Veterinary Oversight of Antimicrobial Use — A Pan-Canadian Framework for Professional Standards for Veterinarians” that is currently being developed. The Council of the ABVMA supports this draft in principal, and our Association’s Council Guidelines on Prescribing, Dispensing, Compounding and Selling Pharmaceuticals will be revised accordingly to reflect the final draft of this framework.

In anticipation of proposed legislative changes by the end of 2016 to prescribing and dispensing by Health Canada, the ABVMA continues to educate its membership, livestock producers and the Alberta public on proper antimicrobial use (AMU) and the emergence of antimicrobial resistance. This awareness is provided in projects funded through several government grants. One grant produced a successful website, social media, and mobile applications. This awareness is also being raised in our general regulations to reflect the updated VPA when it comes into force at proclamation.

**Modifications to the VPA**

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**Amendments to the Veterinary Profession Act (VPA)**

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**Gouvernance pharmaceutique**

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Important projects and participation

The ABVMA continues to expand on important strategic priorities. One of these is member wellness. The ABVMA facilitated 2 Mental Health First Aid courses, one in Edmonton and one in Calgary. Two more are planned for later in 2016 in northern and southern Alberta. A new initiative in animal welfare received rave reviews from the inaugural attendees of the ABVMA Veterinary Forensics Workshop in April. Attendees from the veterinary community, animal welfare organizations and law enforcement learned from experts in pathology, crime scene investigation, forensic reporting, as well as animal cruelty and poisonings. Due to the success of this event, there are plans to host this workshop again in the future in another region of Alberta.

With close to 900 attendees, the annual CanWest Veterinary Conference in beautiful Banff continues to be a success and an excellent opportunity for the entire animal health care team to partake in an extensive educational program. In 2015, the conference began to offer for the first time Registry of Approved Continuing Education (RACE) credits to participants. The ABVMA was privileged to have a representative sit on the University of Calgary Faculty of Veterinary Medicine Decanal Selection Committee. We felt it was important that our Association had the opportunity to be engaged in this process, assist in interviewing the candidates, and be able to provide input into the final selection of the new dean.

Fort McMurray wild fire animal evacuation effort

For a variety of reasons, over 1100 companion animals had to be left behind when the enormous wild fire ripped through Fort McMurray, Alberta in May. Once it was safe to do so, these animals were rescued in Fort McMurray with permission from their displaced owners and then relocated to a temporary facility in Edmonton. The development and operation of this facility — the Fort McMurray Animal Reception Centre, was due to the fantastic efforts of many associations, government agencies, and veterinary industry partners, including the ABVMA, the Alberta Spay Neuter Task Force, the Alberta SPCA,

• Que peuvent faire les producteurs de bétail pour se préparer à ces changements?

L'ABVMA a reçu trois subventions gouvernementales dont elle se servira dans un proche avenir. Deux subventions visent des programmes de formation relativement à la traçabilité afin de former les producteurs de bétail et les vétérinaires sur l'identification et la traçabilité à la ferme. Une autre subvention a été attribuée pour coordonner un atelier de deux jours sur l'utilisation des antimicrobiens. La tenue de cet atelier est prévue pour les 23 et 24 novembre à Edmonton. Grâce au soutien du ministère de la Santé de l'Alberta et du ministère de l'Agriculture et des Forêts de l'Alberta, l'ABVMA présentera cet atelier devant des groupes d'intervenants invités qui comprendront des organismes de réglementation, des agences de la santé ainsi que des groupes pertinents de l'industrie et des denrées. Cet atelier a pour objectif d’élaborer un rapport qui présentera des recommandations en vue d’appuyer la stratégie provinciale concernant la conformité au plan d’action fédéral sur l’utilisation des antimicrobiens.

Projets importants et participation

L'ABVMA continue de travailler à des priorités stratégiques importantes. L'une de ces priorités est le bien-être des membres.

L'ABVMA a animé deux cours de premiers soins sur la santé mentale, un à Edmonton et l'autre à Calgary. Deux autres cours sont prévus vers la fin de 2016 dans le nord et le sud de l'Alberta. L'atelier sur les sciences judiciaires vétérinaires de l'ABVMA, qui s'est tenu en avril, était une nouvelle initiative dans le domaine du bien-être animal et il s'est mérité de grands éloges de la part des premiers participants. Les délégués provenaient de la collectivité vétérinaire, des organismes de bien-être vétérinaire et des services d'application de la loi et ils ont appris auprès d'experts en pathologie, d'enquêteurs en scène de crime, de spécialistes des rapports médiocolégaux et de cruauté envers les animaux ainsi que de toxicologues. En raison du succès de cet atelier, nous prévoyons organiser une nouvelle édition dans une autre région de l'Alberta.

Avec près de 900 participants, la Conférence vétérinaire annuelle CanWest, qui se déroule dans la splendide localité de Banff, continue de connaître un immense succès et d'être une excellente occasion qui permet à toute l'équipe de santé animale de participer à un vaste programme éducatif. En 2015, pour la première fois, la conférence a offert aux participants des crédits de formation continue approuvés par le Registry of Approved Continuing Education (RACE).

L'ABVMA a eu le privilège d'avoir un représentant qui a siégé au Comité de sélection du doyen de la Faculté de médecine vétérinaire de l'Université de Calgary. Nous estimons qu'il était important pour notre association d'avoir l'occasion de participer à ce processus, de contribuer aux entrevues des candidats et de pouvoir fournir notre rétroaction lors de la sélection finale du nouveau doyen.

Effort d’évacuation de Fort McMurray en raison des feux de forêt

Pour diverses raisons, plus de 1100 animaux de compagnie ont dû être laissés dans la ville lorsque l'énorme incendie de brousse a ravagé Fort McMurray, en Alberta, en mai. Une fois qu'il était sécuritaire de le faire, ces animaux ont été secourus à Fort McMurray, avec la permission de leurs propriétaires déplacés, et ensuite logés dans une installation temporaire à Edmonton. La mise sur pied et l'exploitation de cette installation — le Fort McMurray...
the Edmonton Humane Society, and the Calgary Humane Society.

Thanks to the hard work, dedication and generous donation of time and resources from many ABVMA members, the health and welfare of all these animals was ensured and those animals that were ill received the timely medical care they required. Close to 150 veterinarian and veterinary technologist volunteers from the ABVMA community triaged each animal, either on site in Fort McMurray, or once they arrived at the Animal Reception Centre, to determine if they were in need of any medical attention. Many of the volunteer veterinarians and veterinary technologists travelled great distances from all over Alberta to assist. Many of the individuals gave up hours of precious sleep and/or paid work to volunteer. Knowing the importance of the situation, employers and practice owners permitted many of their staff to be absent from their places of employment or clinics to volunteer their valuable services. Nearly 175 practices opened their doors to care for those more critically ill patients, going so far as to provide some pro bono services to assist in the cause. We are truly fortunate to have such caring and generous professionals in our province!

(by Dr. Kevin MacAulay, President, Alberta Veterinary Medical Association)

Obituary

Dr. Michael David Powell

It is with great sadness that the family announced the passing of Michael David Powell, DVM, February 22, 1956 — August 7, 2016, at St. Paul's Hospital in Saskatoon, Saskatchewan. They would like to thank all those for their care and friendship during Michael’s 3-month battle with lymphoma.

Surviving are Michael’s father and mother, Lewis and Ellen Powell of Cincinnati, Ohio; brother Jon Powell of San Diego, California; brother and sister-in-law Jan and Jamie Powell of Cincinnati, Ohio; sister Julie Zigler of St. Petersburg, Florida; and 6 nieces and nephews.

Michael was born and raised in South Bend, Indiana and graduated with honors from the Purdue University School of Veterinary Medicine in West Lafayette, Indiana. He moved to Saskatoon in 1981 to intern at the University of Saskatchewan and then practiced at Central Animal Hospital in Saskatoon for the following 34 years.

Animal Reception Centre, ont été rendues possibles grâce aux efforts sensationnels de bon nombre d'associations, d'agences gouvernementales et de partenaires de l'industrie vétérinaire, dont l'ABVMA, l'Alberta Spay Neuter Task Force, la SPCA de l'Alberta, l'Edmonton Humane Society et la Calgary Humane Society.

Grâce au travail acharné, au dévouement et au généreux don de temps et de ressources de beaucoup de membres de l'ABVMA, il a été possible d’assurer la santé et le bien-être de tous ces animaux et ceux qui étaient malades ont reçu les soins dont ils avaient besoin. Près de 150 vétérinaires et technologues vétérinaires bénévoles de la collectivité de l'ABVMA ont effectué le triage de chaque animal, soit sur place à Fort McMurray, ou à l'arrivée à l'Animal Reception Centre, afin de déterminer s’ils avaient besoin d'attention médicale. Bon nombre des vétérinaires et des technologues vétérinaires bénévoles ont parcouru de grandes distances depuis tous les coins de l’Alberta pour porter assistance. Beaucoup de personnes ont sacrifié de précieuses heures de sommeil et/ou de travail rémunéré pour se porter bénévoles. Compte tenu de l’importance de la situation, les employeurs et les propriétaires de pratiques ont autorisé bon nombre de leurs employés à s’absenter du travail pour offrir bénévolement leurs précieux services. Près de 175 pratiques ont ouvert leurs portes pour soigner les patients gravement atteints, allant jusqu’à offrir des services gratuits pour appuyer la cause. Nous sommes vraiment fortunés d’avoir des professionnels si compatissants et si généreux dans notre province!

Nécrologie

Dr Michael David Powell

C’est avec grande tristesse que la famille a annoncé le décès de Michael David Powell, D.M.V., né le 22 février 1956 et décédé le 7 août 2016, à l’hôpital St. Paul’s de Saskatoon, en Saskatchewan. La famille désire remercier toutes les personnes qui ont offert des soins et de l’amitié durant la lutte de trois mois de Michael contre le lymphome.

Survivent à Michael, son père et sa mère, Lewis et Ellen Powell de Cincinnati, en Ohio; son frère Jon Powell de San Diego, en Californie; son frère et sa belle-sœur, Jan et Jamie Powell de Cincinnati, en Ohio; sa sœur Julie Zigler de St. Petersburg, en Floride; et six neveux et nièces.

Michael est né et a grandi à South Bend, en Indiana, et a obtenu son diplôme avec spécialisation de l’École de médecine vétérinaire de l’Université Purdue à West Lafayette, en Indiana. Il a déménagé à Saskatoon en 1981 pour faire un internat à l’Université de la Saskatchewan et a ensuite exercé au Central Animal Hospital de Saskatoon pendant les 34 années suivantes.
The use of serum beta-hydroxybutyrate to determine whether nursery pigs selected on the basis of clinical signs are anorexic

Amanda M. Perri, Terri L. O’Sullivan, John C.S. Harding, Robert M. Friendship

Abstract — The process of weaning pigs alters intestinal structures and influences piglet behavior, which can result in anorexia. When housed in large groups, affected pigs can be difficult to identify at an early stage. The clinical signs of anorexia include loss in body condition (thinness) and repetitive oral behavior (chomping). The objective of this study was to determine if pigs identified at 4 to 7 days post-weaning on the basis of clinical signs were anorexic based on elevated serum beta-hydroxybutyrate (BHB) levels (ketosis). A total of 240 pigs from 8 farms (30 pigs per farm) were selected based on observation of their abnormal oral behavior (Chomp; \( n = 10 \)), poor body condition, (Thin; \( n = 10 \)), or healthy appearance (Control; \( n = 10 \)). Standard laboratory testing and a ketone handheld meter were used to measure BHB levels and were compared using non-parametric receiver operating characteristic analyses. Most pigs selected based on clinical signs were not anorexic as confirmed by their normal BHB levels.

Résumé — Utilisation du bêta-hydroxybutyrate sérique afin de déterminer si les porcs de pouponnière, sélectionnés en se basant sur les signes cliniques, sont anorexiques. Le processus de sevrage des porcs modifie les structures intestinales et influence le comportement des porcelets, ce qui peut produire de l’anorexie. Lorsqu’ils sont logés dans de grands groupes, les porcs touchés peuvent être difficiles à identifier au début du processus. Les signes cliniques de l’anorexie incluent une perte de condition corporelle (minceur) et un comportement oral répétitif (mordillements). Cette étude avait pour objectif de déterminer si les porcs, identifiés entre 4 et 7 jours après le sevrage en se fondant sur les signes cliniques, étaient anorexiques en se basant sur des taux élevés de bêta-hydroxybutyrate sérique (BHS) (cétose). Un total de 240 porcs de 8 fermes (30 porcs par ferme) ont été choisis sur la base de l’observation de leur comportement oral anormal (mordillement; \( n = 10 \)), mauvaise note d’état corporel, (mince; \( n = 10 \)) ou d’apparence en santé (témoin; \( n = 10 \)). Des tests de laboratoire standards et un compteur de cétone portable ont été utilisés pour mesurer les taux de BHS et ont été comparés en utilisant des analyses non paramétriques de fonction d’efficacité du récepteur. La plupart des porcs choisis en se fondant sur les signes cliniques n’étaient pas anorexiques comme l’ont confirmé les taux normaux de BHS.

Introduction

In commercial swine production weaning is a stressful transition period for piglets. At weaning, piglets are moved to a new environment, transitioned to a solid diet, and mixed with new pen-mates. It is well-documented that within the first few days post-weaning piglets have a significant reduction in feed consumption (1) and growth performance, along with altered intestinal function (2,3). Most piglets are able to transition onto solid feed within a few days of weaning. However, there is a subset of pigs that do not eat solid feed after weaning. These pigs are able to maintain their body condition for approximately 1 week by utilizing fat stores. It can thus be difficult to identify these pigs at an early stage, particularly when they are group-housed.

Almost all pigs experience a period of reduced feed intake for a few days after weaning; however, there are reports of outbreaks of debilitating anorexia in large numbers of newly weaned pigs on some farms (4). This clinical condition has been called periweaning failure to thrive syndrome (PFTS). There are no definitive risk factors, etiological agents, environmental factors, or effective treatments associated with PFTS (5). The PFTS-affected pigs have pathology consistent with starvation,
including thymic atrophy, small intestinal villus atrophy, and superficial gastritis (6). The PFTS-affected piglets are not easily recognized in the early stages and it is suspected that these pigs are likely anorexic for at least a week prior to being identified (7). A common initial clinical sign of PFTS is a repetitive oral behavior of excessive sham chewing (chomping) (7). However, noting this behavior requires careful observation and is possibly a sign of hunger rather than a specific indication of PFTS (8). These PFTS-affected pigs, and in particular the pigs that demonstrate excessive sham chewing, become lethargic and progress to severe debilitation, requiring euthanasia generally within 2 to 3 wk of weaning (4).

A previous study identified increased levels of beta-hydroxybutyrate (BHB) in the serum of weaned pigs within 48 h of their last meal (8). Beta-hydroxybutyrate is a serum ketone produced in the liver and is exported to peripheral tissues for use as an energy source (9). Elevated ketone levels occur due to hepatic fatty acid degradation occurring in the liver and are a result of reduced caloric intake by fasting or anorexia. The metabolic state of increased ketone levels in blood due to the breakdown of fat stores is known as ketosis.

There are no published studies examining ketosis in weaned piglets. This may be due to the rarity of the condition or because it remains undetected due to the absence of diagnostic testing. Therefore, the evaluation of ketone bodies in serum of weaned piglets may be beneficial for prompt detection of anorexia. This may lead to a better understanding of anorexia in nursery pig populations and development of interventions targeted at preventing anorexia in general as well as PFTS.

The main objective of this study was to determine if chomping and thin pigs, observed at 4 to 7 d after weaning, have elevated serum BHB compared to non-chomping pen-mates with good body condition. A secondary objective was to compare serum BHB measurements taken using a pen-side handheld meter and testing using a commercially available BHB assay performed at a veterinary diagnostic laboratory.

Materials and methods

This project was reviewed and approved by the Animal Care Committees at the University of Guelph and the University of Saskatchewan. Eight commercial swine farms were conveniently selected based on willingness to participate in the study. Four farms (SASK 1 to SASK 4) were located in central Saskatchewan and 4 farms (ON 5 to ON 8) were located in southwestern Ontario. At the time of sampling, none of the 8 farms had reported observing PFTS-affected pigs in the nursery. Farm visits were arranged to coincide with a group of pigs being recently weaned (4 to 7 d post-weaning). This time corresponds to the period when the clinical signs of PFTS are typically first observed, and when it is likely to see piglets experiencing anorexia or difficulty transitioning to nursery diets. Thirty pigs per farm were purposefully selected based on observation of their behavior and body condition. Two persons selected the pigs from the SASK farms, and 1 person selected the pigs from the Ontario farms. These 3 individuals selecting the piglets were experienced in identifying the repetitive oral behavior of chomping. This experience stemmed from their previously published work (including the production of a video demonstrating the behavior) on PFTS (7).

In identifying pigs for the 3 groups, all piglets in the weaned batch, regardless of batch size, were observed from outside the pen to allow the piglets to become accustomed to the presence of the observer and to minimize disruption of their behavior. The 3 groups of piglets that were selected from each farm include the Chomp, Thin, and Control groups. Piglets were selected and assigned to the Chomp group (Chomp; n = 10 per farm) if upon observation they displayed repetitive sham chewing (chomping) and licking. Repetitive sham chewing was defined as 4 or more continuous chomps or licks without interruption (8). These pigs were matched with a visually healthy pen-mate in good body condition (Control; n = 10 per farm). Pigs were included in the Control group if they appeared healthy and in good body condition with no overt clinical signs of illness such as diarrhea, coughing, lameness, and did not display repetitive sham chewing. A third group of age-matched pigs were selected for the Thin group (Thin; n = 10 per farm). Pigs were included in the Thin group if they appeared in poor body condition (thinness and hollow flanks), were suspected of being anorexic, and did not display repetitive sham chewing. The pigs were chosen in this manner to simulate how a swine producer might identify sick and healthy piglets in a commercial setting and under practical conditions. Selected pigs were identified using a livestock marker.

Blood sampling and beta-hydroxybutyrate (BHB) measurement

To assess if the selected pigs were ketotic, blood samples were taken from each selected pig. Ontario pigs were bled via the orbital sinus (10) using a Monoject Standard Hypodermic needle 16G × 1" (Covidien, Mansfield, Massachusetts, USA) into 8.5 mL plain tubes (BD Vacutainer; BD, Franklin Lakes, New Jersey, USA). Saskatchewan pigs were bled from the jugular vein using 20G × 1" vacutainer needles and similar plain tubes. Blood samples were stored in a cooler with ice packs while travelling from each commercial farm, and within a few hours after the samples were taken, the samples were centrifuged. The serum was removed and stored at −20°C. The sera from the Ontario blood samples were shipped to Saskatchewan overnight in a cooler with dry ice and frozen cold packs. The serum samples were submitted to the Prairie Diagnostic Services, Saskatoon, Saskatchewan for BHB measurement using an Rx Monza analyzer (Randox Laboratories, Crumlin, County Atrium, UK) as per the manufacturer’s instructions.

While on the farm, immediately after collecting blood from each pig, serum BHB levels in blood were measured pen-side using an Abbott Precision Xtra handheld ketone meter (Abbott Diabetes Care, Alameda, California, USA). This handheld device uses a direct electrochemical test to provide a BHB measurement (mmol/L) within 10 s of applying 1.5 μL of blood to the Precision Xtra blood ketone test strip. The test strip contains the enzyme beta-hydroxybutyrate dehydrogenase, which oxidizes BHB to acetoacetate. This process reduces NADH to NAD+.

The NADH is then re-oxidized by an electron mediator molecule, and the electrical current that is created by the conversion
is measured by the meter, and is directly proportional to the BHB concentration (11).

**Statistical analysis**

**Association between beta-hydroxybutyrate and anorexia.**

Non-parametric tests using SPSS Version 22 (SPSS, Chicago, Illinois, USA) were used to examine associations between ketosis, body condition, and the presence of chomping. In all non-parametric models created, the Rx Monza results were used as the gold standard. The Kruskal-Wallis test was used to assess whether the mean ranks of BHB values differed among groups (Control, Chomp, and Thin) for both testing methods. The Kruskal-Wallis test was used to assess the mean ranks of BHB values from all participating farms. The Mann-Whitney U-test was used to compare the mean ranks of BHB values from different provinces, and to conduct contrasts between the 3 groups: i) Chomp versus Thin; ii) Chomp versus Control; and iii) Thin versus Control.

**Evaluation of diagnostic test agreement.** Three non-parametric receiver operating characteristic (ROC) curves (STATA 12.0 Statcorp, College Station, Texas, USA) were used to assess the overall ability to discriminate ketotic pigs from non-ketotic pigs based on BHB values measured using both testing techniques. A ROC curve is used to illustrate the characteristics of a diagnostic test by graphing the false-positive rate (1 — specificity) on the X-axis and the true-positive rate (sensitivity) on the Y-axis for different cut-off values. Pigs were defined as ketotic if their Rx Monza BHB values were $\geq 0.1$ mmol/L, and were used as the reference variable (gold standard) for the non-parametric ROC analysis. Each pig was identified as either normal or ketotic ($0 = normal, 1 = ketotic$). When using the Precision Xtra to define pigs as ketotic, 3 different cut-points were assessed: i) using the same cut-point as the Rx Monza (ketotic if BHB values were $\geq 0.1$ mmol/L); ii) classifying pigs as ketotic if BHB values were $\geq 0.2$ mmol/L; and iii) classifying pigs as ketotic if BHB values were $\geq 0.3$ mmol/L. Three separate ROC curves were evaluated in which each of these 3 Precision Xtra cutoff values was compared to a Rx Monza cutoff of $\geq 0.1$ mmol/L. The accuracy of the Precision Xtra was assessed by calculating the area under the ROC curve (AUC), which is computed using the trapezoidal rule. An estimate of the variance for the AUC is computed using the trapezoidal rule. An estimate of the variance for the AUC is computed using the trapezoidal rule.

**Results**

A total of 240 pigs were sampled; however, 3 pigs from SASK 2 farm had missing Precision Xtra BHB measurements, because insufficient test strips were available. Nursery pigs selected varied in breed, and all male pigs enrolled in this study had been castrated. The prevalence of ketosis by pig group based on Precision Xtra and Rx Monza BHB measurements is illustrated in Table 1. For both assays, the mean ranks were highest for Thin, intermediary for Chomp, and lowest for Control ($P < 0.001$ for Rx Monza, $P = 0.02$ for Precision Xtra). Post-hoc contrasts indicated Chomp ($P < 0.05$) and Thin ($P < 0.001$) pigs had higher BHB values than those for Control pigs. There was no difference in BHB values between Chomp and Thin pigs ($P > 0.05$). Less than 15% and 7% of Thin and Chomping pigs, respectively, were ketotic based on a Rx Monza cut-off of BHB $\geq 0.1$ mmol/L for defining ketosis. This indicates that clinical signs alone were not sufficient to identify anorexic pigs in the early stages, before significant weight loss occurred.

Mean Rx Monza BHB ranks differed between farms ($P < 0.001$). Regardless of the testing methodology used, pigs on Saskatchewan farms had higher BHB values than those of nursery pigs on Ontario farms ($P < 0.001$).

The ROC curves assessing the agreement between the Precision Xtra and Rx Monza BHB values are presented in Table 2. As informed by the ROC analyses, the most effective BHB cutoff point for determining ketosis on farm when using the Precision Xtra was $\geq 0.2$ mmol/L. This cutoff value had the greatest accuracy, as determined by the AUC, and had a sensitivity of 100%, thus minimizing false positives. Therefore, having 100% sensitivity in addition to a high specificity will allow for pigs to be accurately identified. The Pearson correlation found high correlation in BHB values between the Rx Monza and Precision Xtra BHB values ($r = 0.94$).

**Table 1. Number and percentage of pigs with ketosis by pig group (Control, Chomp, Thin) using different beta-hydroxybutyrate (BHB) cut-off values**

<table>
<thead>
<tr>
<th>Cut-off points for BHB measurements</th>
<th>N</th>
<th>Normal BHB levels</th>
<th>Ketotic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rx Monza $\geq 0.1$ mmol/L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control pigs$^a$</td>
<td>77</td>
<td>100.00%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>($n = 77$)</td>
<td>($n = 0$)</td>
</tr>
<tr>
<td>Chomp pigs$^b$</td>
<td>80</td>
<td>93.75%</td>
<td>6.25%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>($n = 75$)</td>
<td>($n = 5$)</td>
</tr>
<tr>
<td>Thin pigs$^c$</td>
<td>83</td>
<td>86.75%</td>
<td>13.25%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>($n = 72$)</td>
<td>($n = 11$)</td>
</tr>
<tr>
<td>Precision Xtra $\geq 0.1$ mmol/L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control pigs</td>
<td>76</td>
<td>75.00%</td>
<td>25.00%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>($n = 57$)</td>
<td>($n = 19$)</td>
</tr>
<tr>
<td>Chomp pigs</td>
<td>79</td>
<td>68.35%</td>
<td>31.65%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>($n = 54$)</td>
<td>($n = 25$)</td>
</tr>
<tr>
<td>Thin pigs</td>
<td>82</td>
<td>52.44%</td>
<td>47.56%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>($n = 43$)</td>
<td>($n = 39$)</td>
</tr>
<tr>
<td>Precision Xtra $\geq 0.2$ mmol/L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control pigs</td>
<td>76</td>
<td>98.68%</td>
<td>1.32%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>($n = 75$)</td>
<td>($n = 1$)</td>
</tr>
<tr>
<td>Chomp pigs</td>
<td>79</td>
<td>91.14%</td>
<td>8.86%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>($n = 72$)</td>
<td>($n = 7$)</td>
</tr>
<tr>
<td>Thin pigs</td>
<td>82</td>
<td>84.15%</td>
<td>15.85%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>($n = 69$)</td>
<td>($n = 13$)</td>
</tr>
<tr>
<td>Precision Xtra $\geq 0.3$ mmol/L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control pigs</td>
<td>76</td>
<td>100.00%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>($n = 76$)</td>
<td>($n = 0$)</td>
</tr>
<tr>
<td>Chomp pigs</td>
<td>79</td>
<td>93.67%</td>
<td>6.33%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>($n = 74$)</td>
<td>($n = 5$)</td>
</tr>
<tr>
<td>Thin pigs</td>
<td>82</td>
<td>90.24%</td>
<td>9.76%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>($n = 74$)</td>
<td>($n = 8$)</td>
</tr>
</tbody>
</table>

$^a$ Control pigs — non-chomping and visually healthy pen-mate in good body condition and displaying no overt clinical signs of illness such as diarrhea, coughing, or lameness. $^b$ Chomp pigs — piglets that displayed repetitive sham chewing. $^c$ Thin pigs — age-matched pigs that appeared in poor body condition (thinness and hollow flanks) and were suspected of being anorexic.
The authors hypothesize that piglets further along in the clinical course of anorexia would continue to have increased rather than waiting for clinical signs of a disease to occur. This information, therefore, could be useful in monitoring herd outbreaks of various swine diseases, identifying early stages of anorexia. This information, therefore, could support the assumption that serum BHB might be useful in identifying anorexic pigs in the early stages of the problem.

The participating farms for this study were purposely selected based on being PFTS-negative farms and which were not knowingly experiencing disease challenges. This enrollment and piglet selection method was used to replicate how swine producers might detect sick versus healthy piglets in a commercial setting and under practical conditions. However, disease status of the farms may have affected piglet appetite at the time of enrollment. A province effect was found in this study when comparing serum BHB values between Ontario and Saskatchewan farms. However, 1 farm in Saskatchewan included in the study was affected with swine influenza (identified post enrollment), which likely affected the health status (and appetite) of the nursery piglets at the time of sampling. In fact, this farm (SASK 4) had higher mean BHB values for both the Chomp and Thin pigs compared with the other 7 farms, which indicates that these pigs were not in good health, which possibly affected their BHB levels. The remaining 3 Saskatchewan farms also had higher BHB values than those of the Ontario farms. This could indicate that the Saskatchewan farms selected may have had more weaning challenges for the pigs to overcome, or may have been experiencing other disease challenges that could have an effect on their BHB values compared to the Ontario farms. However, disease status of the farms may have affected piglet appetite at the time of enrollment.

The authors hypothesize that piglets further along in the clinical course of anorexia would continue to have increased

### Table 2. Receiver operating characteristic (ROC) curves assessing agreement between the Precision Xtra® and Rx Monza® BHB values

<table>
<thead>
<tr>
<th></th>
<th>ROC #1</th>
<th>ROC #2</th>
<th>ROC #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rx Monza cutoff for defining ketosis (mmol/L)</td>
<td>≥ 0.1</td>
<td>≥ 0.1</td>
<td>≥ 0.1</td>
</tr>
<tr>
<td>Precision Xtra cutoff for defining ketosis (mmol/L)</td>
<td>≥ 0.1</td>
<td>≥ 0.2</td>
<td>≥ 0.3</td>
</tr>
<tr>
<td>Number of (%) ketotic pigs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rx Monza values</td>
<td>16/240 (6.66%)</td>
<td>16/240 (6.66%)</td>
<td>16/240 (6.66%)</td>
</tr>
<tr>
<td>Precision Xtra values</td>
<td>87/240 (36.25%)</td>
<td>24/240 (10.00%)</td>
<td>16/240 (6.66%)</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>100%</td>
<td>100%</td>
<td>81.30%</td>
</tr>
<tr>
<td>Specificity</td>
<td>68.40%</td>
<td>96.40%</td>
<td>98.70%</td>
</tr>
<tr>
<td>Area under curve ± SE</td>
<td>0.84 ± 0.02</td>
<td>0.98 ± 0.01</td>
<td>0.90 ± 0.05</td>
</tr>
<tr>
<td>(95% CI)</td>
<td>(0.81, 0.87)</td>
<td>(0.97, 0.99)</td>
<td>(0.80, 0.99)</td>
</tr>
<tr>
<td>% Classified correctly by</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precision Xtra</td>
<td>70.50%</td>
<td>96.70%</td>
<td>97.50%</td>
</tr>
</tbody>
</table>

Abbott Precision Xtra handheld ketone meter (Abbott Diabetes Care, Alameda, California, USA). This handheld device uses a direct electrochemical test to provide a BHB measurement (mmol/L) within 10 s of applying 1.5 μL of blood to the Precision Xtra blood ketone test strip.

Rx Monza analyzer (Randox Laboratories, Crumlin, County Atrium, UK) as per the manufacturer’s instructions.

Discussion

This study investigated whether measuring serum BHB would help to accurately identify anorexic pigs within the first 4 to 7 d after weaning and possibly earlier than by relying on clinical signs such as chomping or loss of body condition. Ketosis was defined as having a BHB ≥ 0.1 mmol/L for this study. This threshold for defining ketosis for the pigs was based on work conducted by O’Sullivan et al (8) which examined BHB values for weaned pigs of similar age. O’Sullivan et al (8) found that when pigs were anorexic for 48 h the BHB values of the anorexic pigs increased to ≥ 0.1 mmol/L, while pigs with a normal appetite had BHB values ≤ 0.05 mmol/L. The mean serum BHB values of the 2 groups selected on the basis of clinical signs of anorexia (Thin and Chomp) were higher than the Control group selected because the Control group appeared healthy and therefore were assumed to be eating. The ability to identify a significant difference in serum BHB between the 3 piglet groups is important for developing a benchmark for normal BHB and elevated levels in newly weaned pigs. However, of the pigs selected, 94% and 87% of the Chomp and Thin group pigs respectively, had normal Rx Monza BHB levels. It is also likely that the majority of pigs were not completely anorexic, as they may have been eating some food, but their average daily feed intake (ADFI) was decreased. Therefore, not all Chomp and Thin pigs were ketogenic, suggesting these pigs were not completely anorexic. Also, Thin pigs that start eating will be thin much longer than they will be ketogenic. This indicates that the experienced technicians were not able to accurately select pigs that were ketogenic based on behavioral and body condition observations. Thus, these clinical signs may not be helpful for identifying ketogenic pigs. Since chomping is a predominant clinical sign of PFTS, being able to identify pigs that are ketogenic and suspected to be anorexic in the early stage of PFTS will further help to impose diagnostic tests in the earlier stages of the syndrome. Thus, if a producer was unable to correctly identify thin pigs or to patiently observe for chomping pigs, a blood test could be used to identify anorexic pigs in the early stages of the problem.

The participating farms for this study were purposely selected based on being PFTS-negative farms and which were not knowingly experiencing disease challenges. This enrollment and piglet selection method was used to replicate how swine producers might detect sick versus healthy piglets in a commercial setting and under practical conditions. However, disease status of the farms may have affected piglet appetite at the time of enrollment. A province effect was found in this study when comparing serum BHB values between Ontario and Saskatchewan farms. However, 1 farm in Saskatchewan included in the study was affected with swine influenza (identified post enrollment), which likely affected the health status (and appetite) of the nursery piglets at the time of sampling. In fact, this farm (SASK 4) had higher mean BHB values for both the Chomp and Thin pigs compared with the other 7 farms, which indicates that these pigs were not in good health, which possibly affected their BHB levels. The remaining 3 Saskatchewan farms also had higher BHB values than those of the Ontario farms. This could indicate that the Saskatchewan farms selected may have had more weaning challenges for the pigs to overcome, or may have been experiencing other disease challenges that could have an effect on their BHB values compared to the Ontario farms. Also, this could indicate that the 2 individuals selecting the pigs from the Saskatchewan farms were better at finding anorexic pigs than the person selecting pigs from the Ontario farms. Since there are no previous studies in the literature that have assessed serum BHB in newly weaned pigs, the findings of this study provide a baseline, and support the assumption that serum BHB might be useful in identifying early stages of anorexia. This information, therefore, could be useful in monitoring herd outbreaks of various swine diseases, rather than waiting for clinical signs of a disease to occur.

The authors hypothesize that piglets further along in the clinical course of anorexia would continue to have increased
BHB values which also would be increased compared to partially anorexic piglets. This assumption is supported by work completed by O’Sullivan et al (8) who found that when piglets were fasted for 48 h their BHB values were $> 0.1 \text{ mmol/L}$. Additionally, O’Sullivan et al (8) reported that on days 5 to 7 of anorexia, BHB values increased to approximately 0.4 mmol/L. suggesting that when pigs are anorexic for longer periods of time their BHB values will continue to increase (8). However, it is unknown if these BHB values will eventually plateau and, therefore, further research is required. Additionally, O’Sullivan et al (8) reported no signs of clinical disease in the anorexic pigs except for the repetitive chomping behavior, and that when the fasted pigs were re-introduced to feed their BHB levels returned to normal values with the repetitive chomping behavior stopping.

What this present study found was that clinical signs alone are not a reliable indicator of anorexia, and that the measurement of BHB values should be considered.

Additionally, this study found that BHB measurements taken with the Abbott Precision Xtra blood ketone handheld meter on farm showed moderate to good agreement with Rx Monza laboratory assay, based on the ROC analyses found in Table 2. The value of testing on-farm includes convenience, cost-effectiveness, and immediate access to analytical results, compared to submitting samples to a laboratory and waiting for results.

There are many advantages to using the ketone handheld meter for herd-based monitoring. The cost of ketone test strips ($1 per pig) is less than the cost of laboratory testing ($15 per pig), only a small drop of blood is required, and there is no need to ship or process serum or plasma samples to a laboratory. Thus, this technology is suitable for use by farm technicians for assessing anorexia in individual pigs, or prevalence within populations.

This is a novel study, given that there are no previous studies assessing BHB in nursery pigs or comparing 2 testing methodologies. However, the Abbott Precision Xtra blood ketone handheld meter has been used for cattle and found to provide relatively accurate results. In 3 previous studies the results were all similar and comparable (13–15). In total, the 3 studies investigated 622 cows with a 14.1% prevalence of ketosis (11). The average coefficient of determination ($R^2$) when comparing the Precision Xtra handheld meter and the laboratory BHB results was 0.94. The sensitivity of the Precision Xtra handheld meter was 91% and the specificity was 94% for diagnosing ketosis (pooled results between all 3 trials) (11). The same handheld meter was used in this study to assess its on-farm utility and accuracy.

The results from this study indicate that a BHB cut-off value of $\geq 0.2 \text{ mmol/L}$ when using the Precision Xtra produces comparable results to Rx Monza BHB testing with a cut-off value of $\geq 0.1 \text{ mmol/L}$. Therefore, it is recommended to use a $\geq 0.2 \text{ mmol/L}$ cut-off value for determining ketotic nursery pigs when using the Precision Xtra on-farm.

There are a few limitations to this study. Firstly, when selecting pigs from both Ontario and Saskatchewan farms, multiple individuals selected the pigs. Although the individuals are experienced in identifying chomping behavior and thin pigs, there could be some selection bias in this study design. However, selection of anorexic pigs on farm will also be done by different stockpeople, some more skillful than others. When selecting the pigs, the pigs were observed for 5 min per pen. This may not be long enough when searching for piglets that display chomping, but, on most farms, stockpeople will not have more time to observe and select Chomp and Thin pigs. This study did not investigate factors such as dietary ingredients, husbandry differences, or vaccination records which may alter piglet behavior and feed consumption and subsequently have an effect on BHB values. It is known that a high-fat and low-carbohydrate diet can lead to an increase in ketone bodies because an increase in BHB is due to fatty acid degradation in the liver and a reduction in blood glucose levels (16). Future studies should consider these factors to further understand BHB in newly weaned piglets.

In summary, this study found that some pigs in the Thin and Chomp groups had elevated BHB values, and overall the mean BHB values for these 2 groups were higher than for the controls. However, many of the pigs chosen based on the clinical signs of anorexia had BHB values similar to the control pigs in healthy body condition. Our conclusion from this study is that clinical signs of chomping and thinness do not necessarily identify pigs that are anorexic. This suggests that BHB measurement is the more accurate measure of anorexia compared to identifying clinical signs. Lastly, using a $\geq 0.2 \text{ mmol/L}$ cut-off value when using the Precision Xtra on-farm is a practical method to identify anorexic pigs quickly. This may lead to a better understanding of anorexia in newly weaned piglets, and anorexia associated with PFTS or other swine diseases.

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**References**


Veterinary Anesthesia Error Identification, Reduction and Prevention
Fixed-dose-rate administration of gemcitabine in cancer-bearing cats: A pilot study


Abstract — Gemcitabine is an antimetabolite chemotherapy agent with schedule-dependent metabolism and efficacy. The purpose of this study was to identify the fixed-dose-rate (FDR) of gemcitabine administration in cancer-bearing cats that achieved a target plasma concentration (TPC) of 10 to 20 μM. Fifteen client-owned cats received gemcitabine infusions administered at various FDR for 1 to 6 hours. Plasma gemcitabine and dFdU (2’’,2’’-difluorodeoxyuridine), the major gemcitabine metabolite, were quantitated by high performance liquid chromatography. Cats treated with an FDR less than 2.5 mg/m² per minute failed to achieve TPC, whereas cats treated with an FDR of 10 mg/m² per minute provided the longest duration of exposure without exceeding the upper limit of the TPC. Plasma dFdU concentration mirrored plasma gemcitabine concentrations. These data suggest that in order to maintain TPC of gemcitabine in cats the FDR lies between 2.5 and 5 mg/m² per minute. A Phase II study to evaluate efficacy and toxicity of this approach is underway.

Résumé — Administration de gemcitabine à vitesse et à dose fixes chez des chats atteints du cancer : une étude pilote. La gemcitabine est un agent de chimiothérapie antimétabolite ayant un métabolisme et une efficacité qui dépendent du plan thérapeutique. Cette étude visait à identifier la vitesse et la dose fixes (VDF) d’administration de la gemcitabine chez des chats atteints du cancer qui avaient atteints une concentration plasmatique cible (CPC) de 10 à 20 μM. Quinze chats appartenant à des clients ont reçu des infusions de gemcitabine administrées à diverses VDF pendant 1 à 6 heures. La gemcitabine et la dFdU (2’’,2’’-difluorodeoxyuridine) dans le plasma, le métabolite majeur de la gemcitabine, ont été quantifiés par chromatographie liquide à haute performance. Les chats traités à l’aide de VDF de moins de 2,5 mg/m² par minute n’ont pas réussi à atteindre la CPC, tandis que les chats traités à l’aide de VDF de 10 mg/m² par minute ont rapidement dépassé la zone cible. Des VDF de 5 mg/m² par minute ont fourni la durée d’exposition la plus longue sans dépasser la limite supérieure de la CPC. La concentration de dFdU dans le plasma a reflété les concentrations de gemcitabine dans le plasma. Ces données suggèrent qu’fin de maintenir la CPC de la gemcitabine chez les chats, les VDF doivent se situer entre 2,5 et 5 mg/m² par minute. Une étude de phase II pour évaluer l’efficacité et la toxicité de cette approche est actuellement en cours.

Introduction

Gemcitabine (2’’,2’’-difluorodeoxycytidine or dFdC) is an antimetabolite chemotherapy agent with clinical activity against a number of solid tumors in humans, in particular carcinomas, and hematopoietic cancers (1–6). It is a synthetic pyrimidine nucleoside analog, which resembles cytosine arabinoside. This cell cycle phase specific chemotherapeutic drug blocks G1-S transition (1,3,4,7). The inactive form of gemcitabine, dFdC, is sequentially phosphorylated to dFdCTP after it gains entry into the cell. This active form competes with native deoxycytidine triphosphate (dCTP) for incorporation into DNA and inhibits DNA replication and repair, which leads to programmed cell death (1,4).

The formation of dFdCTP is a multi-step process. The first step is rate-limiting and saturable (1,7), and is regulated by deoxycytidine kinase (dCK). In humans, the optimum plasma gemcitabine concentration concentration that results in peak dCK activity and maximal intracellular accumulation of the cytotoxic metabolite, dFdC, is 10 to 20 μM (3,6,7). Importantly, excess gemcitabine plasma concentrations have been shown to inhibit the activity of dCK (1,4). This balance has been tested in vitro in cell lines, ex vivo in freshly isolated human leukemia...
cells, and in vivo in cancer-bearing humans, and is best achieved by continuous (10 mg/m² per minute), long-term (> 30 min) exposure (3,6–8).

Historically, gemcitabine has been administered to humans at high doses over short time intervals, once weekly for 3 consecutive weeks with 1 wk off between cycles (9). In the last decade, the dosing schedule for gemcitabine has transitioned to a FDR with lower concentrations (10 mg/m² per minute) and prolonged infusion times (100 to 150 min). This method of administration is postulated and proven to increase the active metabolite, dFdCTP, within circulating human leukemia cells (3,6,7); however, data for cells within solid tumors are lacking, most likely due to the inability to easily sample such tissues repeatedly.

Catabolism of gemcitabine occurs through deamination by cytidine deaminase (CDA) to difluorodeoxyuridine (dFdU), which is then excreted in the urine (10). A study has evaluated gemcitabine metabolism ex vivo in fresh whole blood from various species (human, dog, cat, horse). This study showed that catabolism of gemcitabine in fresh whole blood is slower in the cat compared to fresh whole blood from dogs, humans, and horses, suggesting the potential need for shorter treatment infusions, lower doses, or longer infusions at lower doses in the cat (11). There is no current standard dosing scheme for the use of gemcitabine in feline patients with cancer. Although its use as a 20- to 30-minute infusion has been reported in several previous studies, gemcitabine has failed to clearly demonstrate clinical efficacy (12–15).

The purpose of this study was to administer gemcitabine as a FDR to cancer-bearing cats and to report, for the first time in this species, plasma concentrations of dFdC and dFdU during infusions.

### Materials and methods

#### Animals

Client-owned cats with various malignancies confirmed by cytology or histopathology were enrolled in the study. Cats had to be at least 1 y old and > 1.5 kg body weight (BW) (Table 1). Baseline complete blood (cell) counts (CBC) and serum biochemistry analyses were obtained to evaluate for any co-morbidities within 2 wk of enrollment into the trial. This was deemed to be sufficient pre-treatment patient assessment in the context of the aims of the study; however, full staging was not carried out. Concurrent supportive therapy, which was prescribed at the discretion of the attending clinician, such as pain medication or antibiotics was permitted. Complete blood (cell) counts were obtained only prior to each subsequent infusion of gemcitabine. Cats had to have at least 5000 peripheral blood mononuclear cells (PBMCs)/µL and > 2000 neutrophils/µL of blood to be considered for entry into the trial and before each infusion. Cats were permitted to receive infusions at different fixed dose rates (FDR) no more than once every 2 wk. Cats were not allowed to receive the same FDR more than once. Clients provided signed informed consent with understanding of the investigational goals of the study and could withdraw their cat from the study for any reason and at any time. This study was approved by both the Institutional Animal Care and Use Committee (protocol 16192) and the Clinical Trial Review Board.

#### Drug preparation

Gemcitabine (dFdC) is a commercially available chemotherapeutic agent and supply is consistent. It was reconstituted using sterile saline per the manufacturer’s (Sandoz, Princeton, New Jersey, USA) recommendations (final concentration 38 mg/mL).

#### Plasma preparation

Cats treated in this study had a sterile indwelling catheter placed in a peripheral vein. Blood (1 mL) was drawn before infusion, hourly during infusion, and at the end of infusion (EOI) into a lithium heparin tube and the plasma was separated immediately by centrifugation at 400 × g at room temperature for 5 min. The plasma proteins were precipitated by mixing with an equal volume of 6% sulfasalicylic acid (SSA). Precipitated proteins were separated by centrifugation as described and the protein-free plasma was frozen (~80°C) until the dFdU and gemcitabine were quantitated by high performance liquid chromatography (HPLC).

#### Fixed-dose-rate administration

The concentration of the commercially prepared gemcitabine was high (38 mg/mL); therefore, the resulting volume to be infused was small. Thus, the total calculated drug dose was further diluted with normal saline to a final volume permitting an infusion rate of 10 mL/h by syringe pump (Medfusion 3500; Smith Medical ADS, St. Paul, Minnesota, USA). For instance, a cat that was scheduled to receive 380 mg of gemcitabine over 6 h would have 10 mL of prepared gemcitabine brought to a volume of 60 mL.

#### Analytical procedures

To determine the concentration of plasma gemcitabine and dFdU, an HPLC chromatograph (Model ALC-204; Waters Associates, Milford, Massachusetts, USA) equipped with 2 pumps (Model 6000A; Waters Associates), and a gradient programmer (Model 660; Waters Associates) was used to fractionate

<table>
<thead>
<tr>
<th>Subject</th>
<th>Disease</th>
<th>Age (years)</th>
<th>Number of infusions</th>
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<tr>
<td>1</td>
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</tr>
<tr>
<td>15</td>
<td>CA, pancreas</td>
<td>15</td>
<td>6</td>
</tr>
</tbody>
</table>

OSCC — oral squamous cell carcinoma; CA — carcinoma; ISS — injection site sarcoma; SCC — squamous cell carcinoma.

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plasma effects of prolonged gemcitabine administration, cats were treated with gemcitabine at 1, 2.5, 5, or 10 mg/m² per minute for 1 h, plasma concentration of gemcitabine ranged from 0.4 μM to 1.7 μM. When administered

Determination of plasma levels of gemcitabine and dFdU

The study was carried out in 2 parts. In the first part, a 1-hour infusion was administered at various dose rates to determine if the proposed TPC could be achieved. In the second part of the study, the duration of infusion was varied to assess the threshold for and duration of the TPC.

1-hour infusion. While unknown in the cat, in vitro and in vivo work have identified the optimal plasma concentration of gemcitabine to range between 10 μM and 20 μM and this concentration is reached within 1 h of a 10 mg/m² per minute infusion in humans (3,6,7). Thus, the threshold for achieving the target plasma concentration (TPC) for the cats in this study was also set to 10 to 20 μM. Cats in this arm were started at the first visit with 1 mg/m² per minute and were allowed to receive 2.5, 5, 7.5 and then 10 mg/m² per minute for 1 h at each subsequent infusion. Seventeen gemcitabine infusions were delivered to 5 cats and the plasma gemcitabine and dFdU concentrations were quantitated as described in analytical procedures.

Multiple-hour infusions. In vitro, ex vivo, and in vivo human studies have shown that prolonged exposure of neoplastic cells to gemcitabine results in increased intracellular accumulation of the active metabolite of gemcitabine and that these higher intracellular levels result in increased cellular cytotoxicity and improved therapeutic efficacy (3,6,7). The 1-hour infusion data were used to guide dosing in the multiple hour group. To evaluate the plasma effects of prolonged gemcitabine administration, cats were treated with gemcitabine at 1, 2.5, 5, or 10 mg/m² per minute for 2, 4, or 6 h and the plasma levels of gemcitabine quantitated as described in analytical procedures. Some cats received more than 1 infusion, but always at different dose schedules and plasma was collected at each hour of infusion for analysis.

Plasma dFdU was quantitated in each sample assayed as described in analytical procedures.

Results were plotted as either EOI plasma gemcitabine and dFdU (μM) versus dose gemcitabine (mg/m² per minute) or plasma gemcitabine and dFdU versus time. A non-linear regression line of the median plasma gemcitabine and dFdU with respect to both time and drug dose were plotted using least squares method and commercially available software (GraphPad Prism 6; GraphPad Software, La Jolla, California, USA).

Toxicity. If available, treatment-related adverse events were graded according to the Veterinary Cooperative Oncology Group Common Terminology Criteria for Adverse Events (VCOG-CTCAE) v1.1 (16).

Results

Cats (n = 15) with various malignancies (Table 1) received 61 infusions of gemcitabine as described below. The interval between infusions varied from once every 2 wk to once every 4 wk. Cats were either castrated males (n = 9) or spayed females (n = 6) with a median age of 12 y (range: 6 to 15 y), a median weight of 5.3 kg (range: 1.8 to 6.1 kg) and domestic short (n = 14) or long (n = 1) hair.

1-hour infusion

To determine the FDR that achieves the TPC, 5 cats were administered gemcitabine at 1 (n = 5), 2.5 (n = 5), 5 (n = 5), 7.5 (n = 3), and 10 (n = 3) mg/m² per minute for 1 h (Figure 1A). Two cats were withdrawn from the study before completing all 5 infusion levels due to temperament. When administered at 1 mg/m² per minute for 1 h, plasma concentration of gemcitabine ranged from < 0.4 μM to 1.7 μM. When administered
at 2.5 mg/m² per minute for 1 h, plasma concentration ranged from 2 to 4.5 μM. Infusions delivered at 5 mg/m² per minute for 1 h resulted in plasma concentrations that ranged from 3.7 to 12.3 μM. The administration of gemcitabine at 7.5 mg/m² per minute for 1 h resulted in plasma concentrations that ranged from 4.8 to 8.9 μM. When administered at 10 mg/m² per minute for 1 h, plasma concentrations ranged from 6.7 to 17 μM. Only 1 out of the 3 cats in this group achieved TPC. The plasma concentration of dFdU (Figure 1B) remained less than 3 μM (range: 0.0 to 2.6 μM).
Multiple hour infusions

Thirteen cats were treated in this arm, 3 of which had been previously included in the 1-hour group. A total of fourteen 2-hour infusions (n = 9 cats), a total of seventeen 4-hour infusions (n = 13 cats), and a total of thirteen 6-hour infusions (n = 8 cats) were delivered at 1 (n = 6 cats; 9 infusions), 2.5 (n = 4 cats; 12 infusions), 5 (n = 5 cats; 9 infusions), or 10 (n = 5 cats; 8 infusions) mg/m² per minute. Data for 6 of the multiple-hour infusions were not collected during the infusion due to patient temperament.

Cats treated with gemcitabine at 1 mg/m² per minute for up to 6 h had low plasma dFdC concentrations (range: 0.18 to 7.7 µM) (Figure 2A) and the dFdU concentration ranged from 0 to 5.4 µM. Most cats treated with 2.5 mg/m² per minute achieved TPC (range: 10.1 to 14.8 µM) between 3 and 5 h (Figure 2B). One cat did not achieve a plasma concentration within the TPC range even after a 5-hour infusion, but did so at 6 h. The dFdU concentration at this FDR for 0 to 6 h was a range of 0 to 12.7 µM. Those subjects treated with 5 mg/m² per minute achieved TPC (range: 12 to 18.8 µM) after 2 h of infusion, began to exceed the TPC range after 3 h, and no cat remained within the TPC range when the infusion was continued beyond 4 h (Figure 2C). The plasma dFdU ranged from 0 to 15.1 µM. Finally, cats treated with 10 mg/m² per minute (Figure 2D) began to reach TPC within 1 h of infusion (range: 2.0 to 14 µM), and the majority exceeded the TPC when infusions were continued for 2 h or longer (range: 23.8 to 38.2 µM). The dFdU concentration in cats treated at a FDR of 10 mg/m² per minute for 0 to 6 h ranged from 0 to 14.5 µM. Four cats had detectable dFdU levels (range: 1.3 to 4.5 µM) at 0 h 2 wk after administration of dFdC (Figure 2B–C).

Toxicity

Evaluation of toxicity was not an endpoint of this trial and therefore adverse events were not recorded consistently. However, 4 of the 5 cats treated with 1-hour infusions of various FDR had CBCs and chemistry panels performed 1 wk after infusion. No hematological or biochemical toxicities were observed. Additionally, there were 3 cats (patient numbers 1, 5, 10) treated at 10 mg/m² per minute (1 treated at 2 h, 2 treated at 6 h) that developed significant bone marrow toxicity. Two out of 3 cats developed a fever, and 2 out of 3 had documented grade IV neutropenia. One of the febrile cats was treated supportively at the referring veterinarian but a record of the grade of neutropenia was unavailable for review. All 3 cats recovered uneventfully after treatment with intravenous fluids and antibiotics. Two out of the 3 cats (patient numbers 1 and 10) went on to receive additional doses of gemcitabine chemotherapy.

Discussion

Gemcitabine is a nucleoside analog with activity against various malignancies in human oncology (1–6). Efficacy in veterinary patients has been limited, and evaluation of an optimal dosing regimen is lacking in small animal patients (12–15). This is the first in vivo study evaluating plasma concentration of gemcitabine and its metabolite, dFdU, in the cat. In the last 10 y, gemcitabine administration in humans has changed from a high dose for a short period of time to a lower dose for longer, continuous infusions. A study comparing intracellular dFdCTP in PBMCs from patients with pancreatic adenocarcinoma treated with gemcitabine weekly on days 1, 8, and 15 of a 4-week cycle at 2200 mg/m² over 30 min (73 mg/m² per minute) versus 1500 mg/m² over 150 min (10 mg/m² per minute) (8) proved the utility of this transition. Patients who received the FDR infusion had a 2-fold increase in intracellular dFdC concentration in PBMCs used as surrogate tissue, and importantly experienced a survival benefit over those patients treated with the standard 30-minute infusion.

The optimal dose or administration schedule of gemcitabine for cats has not been established. The veterinary literature reports treatments in cats with various malignancies (12–15) using gemcitabine as a 30-minute infusion. These reports are reminiscent of the early dosing in humans, and were in fact extrapolated from human studies (9). In these feline studies when gemcitabine was administered weekly or twice weekly, bone marrow and G1 toxicity were dose-limiting. Consequently, in order to allow adequate recovery of normal tissues without the potential of compounding toxicity in cats that received multiple infusions, an interval of a minimum of every 2 wk was chosen.

Although evaluation of toxicity was not a goal of this study and limited data were available, when administered once as a 1-hour infusion, there was minimal bone marrow toxicity. We don’t know if administration at more frequent intervals would result in cumulative toxicity. Our data suggest an FDR of 10 mg/m² per minute for multiple hours may lead to untoward toxicity. In addition, when evaluating Figure 2D, an FDR of 10 mg/m² per minute at 5 and 6 h exceeded the high end of the TPC; therefore, there would be limited justification for treating cats at this FDR. There were not enough data to draw conclusions about the potential for toxicity in cats treated at 10 mg/m² per minute for 2 and 4 h. In future studies, complete toxicity evaluation of FDR at various doses (for any length of time) will help guide the determination of the maximally tolerated dose and dose limiting toxicities.

Evaluation of tumor response was also not a primary goal of this study. As designed, the study allowed cats to receive gemcitabine infusions at different dosages for different lengths of time. The time interval between infusions also varied from once every 2 to once every 4 wk. Thus, ascribing response to a specific gemcitabine FDR was difficult. Where response was mentioned in the medical record, 2 cats had subjective responses (patient numbers 1 and 2). In order to achieve the goal of our study, doses of 1, 2.5, 5, 7.5, and 10 mg/m² per minute delivered over 60 min were initially evaluated to assess for the first time, the range of plasma gemcitabine accumulation that could be achieved. An upper limit of 10 mg/m² per minute was chosen because this dose is the standard used in humans. Analysis of the 1-hour infusion data revealed that an FDR of 10 mg/m² per minute provided data points within the TPC in the 3 cats evaluated (Figure 1A). Thus, the first cohort of multiple-hour infusions began at this level. The plasma gemcitabine concentrations from most of the cats treated with multiple hours of an FDR of 10 mg/m² per minute exceeded the target range by 3 h (Figure 1D). We therefore began the next cohort of cats
at 1 mg/m² per minute (Figure 2A) and all of these cats failed to achieve the TPC even after 6 h. Cats treated with an FDR 2.5 mg/m² per minute (Figure 2B) did achieve TPC, however, only after 3 h and did so at the low end of the range. When treated at 5 mg/m² per minute (Figure 2C) the cats in this study remained in TPC for the longest period; however, several data points still exceeded the upper limit. We elected not to treat cats at 7.5 mg/m² per minute because we anticipated that the levels would be higher than those obtained at 5 mg/m² per minute.

Prolonged exposure of cells to the active metabolite, dFdC-TP, improves efficacy of the drug and may provide clinical benefit to the patients treated (8). It has also been shown that the rate-limiting metabolic activation step requiring the enzyme dCK is saturated at an infusion rate of 10 mg/m² per minute IV in humans (7). Our data demonstrated that a FDR of 5 mg/m² per minute provided the longest duration of plasma gemcitabine concentrations in the proposed target range.

For proof of concept, measurement of dFdC-TP in tumor cells or incorporation of gemcitabine into DNA would be required. Repeat biopsies of tumor tissue for evaluation of gemcitabine levels in the target cells would further strengthen the findings of this study; however, morbidity to the patient precluded this action.

The breakdown of gemcitabine produces a metabolite, dFdU, which was successfully measured in the cats in this study (Figure 1, 2A–D). When gemcitabine was administered for 1 h at any FDR (Figure 1B) or at a FDR of 1 mg/m² per minute for 6 h (Figure 2A lower graph), the levels of dFdU remained low. Above a FDR of 2.5 mg/m² per minute, dFdU concentrations rose with increasing duration of infusion, but did not surpass 15.1 µM, despite increasing concentrations of plasma dFdC. This suggests that the degradation of dFdC by feline CDA is a saturable process. While a study evaluating human CDA utilizing dFdC as a substrate has been performed (22), no such study exists for feline CDA. Interestingly, detectable levels of dFdU were found repeatedly in several cats receiving multiple infusions 2 wk after the previous gemcitabine administration (Figure 2B–C, refer to 0 h time-point on the dFdU graphs). While some cats may have dFdU persist in circulation for at least 2 wk, correlation to the FDR level or the duration remains to be determined. This finding may be due to the decreased degradation of gemcitabine observed in the cat (11). This slower degradation may explain the unexpected toxicity observed in cats treated with gemcitabine twice weekly as a radiosensitizer (14) because dFdU itself has been shown to be a radiosensitizer under hypoxic conditions (23).

There were several limitations of this study including small patient number, and lack of complete pharmacokinetic data and evaluation of the intracellular active metabolite. There was also incomplete toxicity and tumor response data, as well as incomplete data collection due to patient compliance in both the 1-hour and multiple-hour studies. The 1-hour infusion cohort was small (3 to 5 cats) and data from this group were meant to guide the remainder of the study. However, there was overlap of the plasma dFdC concentrations at FDR of 5, 7.5, and 10 mg/m² per minute (Figure 1A). Armed with these data, we anticipated that the FDR that achieved TPC in the cat would be similar to that of humans (i.e., 10 mg/m² per minute). When we extended infusions to multiple hours, there was great interpatient variability in the plasma dFdC and dFdU at all FDR tested. This interpatient variability has also been seen in human studies (3). These findings highlight the need for quantitation of plasma dFdC in future clinical trials. Lack of complete pharmacokinetic data prevented us from defining an area under the curve that would maximize the time at the TPC. The quantitation of the active intracellular metabolite, dFdC-TP or the quantity of gemcitabine incorporated into DNA would provide further evidence that the optimal plasma gemcitabine concentration of 10 to 20 µM in humans is also ideal in cats. Finally, complete toxicity profile and tumor response data were not primary goals of this study and thus were not consistently obtained. Gathering such data in future trials in which a larger cohort of cats are treated with the same FDR for a defined period of time would allow complete evaluation of both adverse events and tumor responses. Additionally, administering a higher dose rate of gemcitabine for a short period of time in order to achieve TPC rapidly followed by a lower FDR over a longer period of time to maintain steady state is a considered goal of future studies.

In conclusion, the FDR to achieve and maintain TPC levels in the cat was found to range between 2.5 and 5 mg/m² per minute. The optimal dose remains to be determined. Our findings warrant investigation of gemcitabine administered as a FDR to additional cats with neoplasia in order to evaluate therapeutic benefit and treatment-related toxicities. A Phase II study of FDR gemcitabine in cats with cancer is currently underway.

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References


Glove perforation rate with orthopedic gloving versus double gloving technique in tibial plateau leveling osteotomy: A randomized trial

Kimberly Egeler, Nicole Stephenson, Natasha Stanke

Abstract — In this randomized, prospective study, perforation rates, glove change rates, and cost between orthopedic gloves (n = 227) and double gloving with standard latex surgical gloves (n = 178) worn in tibial plateau leveling osteotomy procedures were compared. Gloves were collected from the surgeon and surgical resident after procedures and were tested for perforations with a standardized water leak test, as described by the American Society for Testing and Materials International. No statistically significant difference was found between the perforation rate using orthopedic gloving and double gloving techniques (P = 0.629) or the rate at which gloves were changed (P = 0.146). Orthopedic gloving was 2.1 times more costly than double gloving but they may be preferred by surgeons for dexterity and comfort.

Introduction

Surgical gloving is a standard of modern medical sterile practice. Gloving was first used in 1889 to protect caregivers’ hands from harsh disinfecting chemicals (1). Currently, gloving is used to protect both the patient and the caregiver from transmissible disease and the patient from surgical site infection (2–4). Perforation of surgical gloves during procedures eliminates this protective barrier and increases the risks to both the patient and caregiver (3,4).

Previous studies have investigated factors that increase risk of glove perforation in veterinary medicine. These risk factors include surgical duration, orthopedic procedures, use of power instruments or wire, role as primary surgeon versus assistant, and polyisoprene (rubber) glove material (5,6). Previously reported rates of perforation range from 3.34% to 23.3% in human and veterinary medicine (5,7–9).

Numerous types of gloves and gloving techniques are available. These include standard latex surgical gloves, double gloving, orthopedic gloves (which are typically a thicker material), and various other materials. Among these different gloving types and techniques there are variations in cost, comfort, dexterity, and perforation rates (7–10).

Previous studies in human medicine have shown that double gloving decreases perforation rates during surgical procedures compared to single gloving (7,8,10). One study revealed that there was no difference between orthopedic gloving and double gloving in human obstetric cases (9). To the authors’ knowledge no studies have been performed in veterinary medicine comparing single orthopedic gloving to double gloving techniques. The purpose of this study was to compare the perforation rates of single orthopedic gloving to double gloving with standard latex surgical gloves in tibial plateau leveling osteotomies (TPLO) performed in dogs. The null hypothesis was that there would be no difference in perforation rates between these 2 groups.
Materials and methods

Data collection
From September 2014 to May 2015, board-certified surgeons, veterinarians limited to the practice of surgery, and surgical residents from 2 small animal private practice specialty hospitals were randomly assigned to wear orthopedic gloves (Cardinal Health Triflex Orthopedic, Waukegan, Illinois, USA) or to double glove with standard latex surgical gloves (Ansell Sensi-touch, Dothan, Alabama, USA) for single session TPLO in dogs. Glove pairs collected were counted monthly and the trial was discontinued after 185 pairs of gloves had been collected. Orthopedic gloves were made of rubber latex and had an average thickness at the cuff of 0.235 mm, at the palm of 0.305 mm, and at the finger of 0.339 mm, as reported by the manufacturer. Standard latex surgical gloves were also made of rubber latex and had an average thickness at the cuff of 0.24 mm, at the palm of 0.22 mm, and at the finger of 0.23 mm, as reported by the manufacturer. All participants double-gloved with the inner glove being 1 size larger than normally worn by the participant and the outer glove being the size normally worn by the participant. If a known perforation occurred during a procedure, gloves were changed and the original gloves were included in the statistical analysis. After the procedure, gloves were rinsed of any blood or tissue and collected in plastic bags. Data recorded for each glove included participant name, primary surgeon versus assistant, dominant hand, procedure length, and any known glove perforation or glove changes. Gloves were stored in sealed plastic bags at room temperature (−21°C) for no longer than 10 mo before testing. All gloves were tested prior to the expiration date indicated by the manufacturer. Cases were excluded before randomization if performance of a second surgical procedure was planned (including bilateral TPLO). Gloves were censored if they were missing or lost before testing, if a glove different from the 2 brands specifically indicated for this study was used, and when complete leak testing could not be performed (a single pair of gloves that were torn during removal).

Water leak testing
All water leak tests (WLT) were performed as described by the American Society for Testing and Materials (ASTM) International in the FDA approved, validated testing method; ASTM D5151 (11). Specifically, all gloves were suspended in the air for 2 min with at least 1000 mL of water inside the glove and observed for streams or droplets of water. Positive perforation was defined as the presence of streams or droplets of water on the outside of the glove.

Experimental gloves
A power analysis was completed before initiation of the study to determine the target sample size. The parameters used in the calculation for a 2-tailed test were: alpha of 0.05, beta of 0.20, a minimum detectable effect size of 10%, and 1:1 ratio between groups. Based on prior data on perforation rates for orthopedic gloves we used an estimated perforation rate of 7% versus 17%, which gave a target sample size of 185 individual gloves (or glove sets in the case of double gloving) in each group (9). All study gloves underwent WLT as described. For double gloving, positive perforation was defined as a droplet or stream present in both the inner and outer gloves of the set of standard latex surgical gloves of the same hand. This glove set was considered a single glove perforation for statistical analysis.

Statistical analysis
All data were entered into and maintained in a computer spreadsheet program (Excel 2011; Microsoft, Redmond, Washington, USA). The independence of perforation rates between the right and left hand glove worn during the same procedure was assessed using a Chi-square test of homogeneity using the overall perforation rate to calculate the expected proportion of single- and double-handed perforations. Associations between categorical variables (primary surgeon versus assistant, dominant hand versus non-dominant, glove type, perforation, unknown perforation, and glove change) and calculation of odds ratios were determined with Fisher’s exact tests. Univariate logistic regression was used to determine if glove perforation increased with procedure length and to determine if glove storage time was similar between groups.

Statistical analyses were performed using a statistical software package (“R”, R-Development Core Team, www.r-project.org). Factors were considered statistically significant if the P-value was < 0.05. Cost analysis of glove types was performed using TreeAge Pro 2015 software (TreeAge Software, Williamstown, Massachusetts, USA). Costs of gloves used in the study were obtained from Patterson Veterinary Supply of Devens, Massachusetts for the standard latex surgical gloves and MWI Animal Health of Biose, Idaho for the orthopedic gloves. Glove cost per procedure was determined assuming 2 pairs of gloves would be used for orthopedic gloves, 3 if changed, and 4 pairs of standard latex surgical gloves would be used for double gloving, 5 if changed, to account for both the primary surgeon and the assistant. Frequency of glove change was accounted for with a binomial distribution.

Results
Experimental gloves
A total of 115 pairs of orthopedic gloves and 93 pairs of double glove sets (the inner and outer glove of the same hand) of standard latex surgical gloves were used by primary surgeons or assistants during the study period (Figure 1). Of the double glove set pairs, censored gloves included 1 that was torn, 3 that were lost prior to testing, and 2 pairs that were the wrong brand, resulting in 178 individual glove sets for analysis (Table 1). Three orthopedic gloves were lost prior to testing and therefore excluded from the analysis (censored), resulting in 227 individual gloves for analysis. The number of gloves censored and storage time prior to testing did not differ significantly between treatment groups (P = 0.070 and P = 0.211, respectively). The expected frequencies of perforation within glove pairs, assuming each glove perforation was independent (neither glove perforated: 173; single glove perforated: 26; both gloves perforated: 1), were not significantly different than observed (175, 22, 3; P = 0.989). During the surgical procedure a single glove was changed on 6 occasions (3.4%) for double gloves (inner and
outer glove) and on 2 occasions (0.9%) for orthopedic gloves due to a known perforation; this difference was not significant (OR: 3.9; \(P = 0.146\)). When gloves were changed during a procedure, only the original gloves were used for statistical analysis.

The perforation rate was 7.9% (18/227; 95% CI: 4.8% to 12.2%) for orthopedic gloves and 6.2% (11/178; 95% CI: 3.1% to 10.8%) for double gloves, which were not significantly different (OR: 0.77; \(P = 0.629\)). The perforation rate for only the outer glove from the double glove sets, which is a proxy measure of single glove perforations, was 26.4% (47/178; 95% CI: 20.1% to 33.5%) (9). Of the 29 glove perforations that occurred, 86% (10 double gloves and 15 orthopedic gloves) were unnoticed at the time of perforation and there was no difference between glove types (OR: 0.51; \(P = 1\)). There was no difference in perforation rate between gloves from dominant and non-dominant hand (\(P = 0.849\)) or gloves from primary surgeon and assistant (\(P = 1\); Table 2). Risk of both overall and unknown glove perforation increased with procedure length (\(\beta = 0.029, P = 0.003\) and \(\beta = 0.171, P = 0.036\), respectively).

Glove perforations occurred most commonly at the tip of the 1st and 2nd digit (34 and 12 times, respectively). The location and frequency of all glove perforations that occurred are listed in Table 3. Perforations, as defined in this study, did not include double glove perforations in which only the inner or outer glove was perforated. Therefore, not all perforations listed above were used for analysis.

**Cost analysis**

Cost per glove pair was $1.56 for orthopedic gloves and $0.37 for standard latex surgical gloves used for double gloving. Glove cost per procedure was $3.13 to $3.18 for orthopedic gloves and $1.49 to $1.51 for double gloving when accounting for number of pairs used and frequency of glove changing. Orthopedic gloving was therefore 2.1 times more costly.

**Discussion**

There was no significant difference in the perforation rate of orthopedic gloving compared to double gloving. Although double gloving was more cost-efficient, it has been reported that compared to single orthopedic gloving, double gloving may lead to numbness and loss of dexterity (9). Based on these findings, surgeons should take into account not only the increased cost of orthopedic gloving but also comfort and personal preference when deciding which type of gloving to use.

Both orthopedic and double gloving techniques have characteristics intended to improve durability. The orthopedic gloves used in this study are 0.305- to 0.339-mm thick, compared to the 0.22 to 0.23 mm thickness of the standard latex gloves used in this study. Double gloving adds an entire second layer of protection, totaling 0.44 to 0.46 mm. Given these modifications, it is not surprising that these techniques had similar perforation rates. The perforation rates in this study (8% for orthopedic gloves and 6% for double gloves) were similar to
previously reported rates for double (0% to 7%) and orthopedic gloving (7%) and less than those reported for single gloving (9% to 11%) (7–9).

This study showed that a large percent (86%) of glove perforations were unnoticed by the wearer. This is consistent with previously reported findings (5–7,9). There was no significant difference in unnoticed perforations between treatment groups, indicating that gloving technique did not improve the detectability of glove perforation during surgery. Unnoticed glove perforations increase the potential for surgical site contamination because these gloves and any contaminated instruments continue to be used for the remainder of the surgical procedure. This study showed that as surgery time increased, perforation rate and unknown perforations also increased. Both of these findings are consistent with findings of previous reports (6). Based on these findings, surgeons and assistants should look for perforations more carefully during surgery to ensure that proper glove and instrument changes are performed.

In the present study, there was no significant difference in the frequency of glove changes between groups. Participants changed gloves during surgery if a known perforation or contamination occurred. One glove change occurred due to numbness and a desire for larger glove sizes, but this change was not included in the statistical analysis. Excessive glove changes interrupt and distract surgeons and assistants from performing the task at hand and add unnecessary time to the procedure. Intraoperative glove changes may also have potential for additional contamination.

Single standard latex surgical glove perforation rates were not independently assessed in this study because the previous research suggests that the risk of exposing patients to surgical site contamination due to perforation was too great for single standard latex surgical gloving (2–4,7,8,10). However, we calculated a proxy measure of perforation rate for single standard latex surgical gloving using the perforation rate of outer gloves from the double gloving group as previously described (9). Unsurprisingly, this perforation rate of 26% was much greater, though not evaluated statistically due to correlation with the procedure length.

For double gloving, a true perforation was recorded when a loss of a sterile barrier occurred, although it was not clear how this occurred. One glove change occurred due to numbness and a desire for larger glove sizes, but this change was not included in the statistical analysis. Excessive glove changes interrupt and distract surgeons and assistants from performing the task at hand and add unnecessary time to the procedure. Intraoperative glove changes may also have potential for additional contamination.

Table 1. Analysis of differences in glove perforations for double gloves versus orthopedic gloves

<table>
<thead>
<tr>
<th>Variable</th>
<th>Double gloves (n = 178)</th>
<th>Orthopedic gloves (n = 227)</th>
<th>Odds ratio</th>
<th>P-valuea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gloves censored</td>
<td>8</td>
<td>3</td>
<td>3.4</td>
<td>0.070</td>
</tr>
<tr>
<td>Gloves changed</td>
<td>6</td>
<td>2</td>
<td>3.9</td>
<td>0.146</td>
</tr>
<tr>
<td>Perforations</td>
<td>11</td>
<td>18</td>
<td>0.77</td>
<td>0.564</td>
</tr>
<tr>
<td>Unknown perforationsb</td>
<td>10</td>
<td>15</td>
<td>0.51</td>
<td>1</td>
</tr>
<tr>
<td>Storage time in days</td>
<td>126.7/125</td>
<td>118.5/117</td>
<td>NA</td>
<td>0.211</td>
</tr>
</tbody>
</table>

a P-values were calculated using Fisher’s exact tests for categorical data and logistic regression for continuous data.
b Unknown perforations were assessed out of total number of perforations.
NA — not applicable.

Table 2. Glove perforation rates for gloves on dominant hand versus non-dominant hand, for gloves worn by primary surgeon versus assistant surgeon, and in relation to duration of procedure

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of gloves perforated</th>
<th>Number of gloves not perforated</th>
<th>Percentage perforated</th>
<th>P-valuea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dominant hand</td>
<td>14</td>
<td>191</td>
<td>6.8</td>
<td>0.849</td>
</tr>
<tr>
<td>Non-dominant hand</td>
<td>15</td>
<td>185</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>Primary surgeon</td>
<td>16</td>
<td>213</td>
<td>6.9</td>
<td>1</td>
</tr>
<tr>
<td>Assistant surgeon</td>
<td>13</td>
<td>163</td>
<td>7.4</td>
<td></td>
</tr>
<tr>
<td>Procedure length in minutes</td>
<td>55.8/60</td>
<td>66.5/65</td>
<td>NA</td>
<td>0.003</td>
</tr>
</tbody>
</table>

a P-values were calculated using Fisher’s exact tests for categorical data and logistic regression for continuous data.

Table 3. Location and frequency of glove perforations

<table>
<thead>
<tr>
<th>Location</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tip of 1st digit</td>
<td>34</td>
</tr>
<tr>
<td>Tip of 2nd digit</td>
<td>12</td>
</tr>
<tr>
<td>Tip of 3rd digit</td>
<td>5</td>
</tr>
<tr>
<td>Tip of 4th digit</td>
<td>4</td>
</tr>
<tr>
<td>Tip of 5th digit</td>
<td>2</td>
</tr>
<tr>
<td>Base of 1st digit</td>
<td>4</td>
</tr>
<tr>
<td>Base of 2nd digit</td>
<td>1</td>
</tr>
<tr>
<td>Base of 3rd digit</td>
<td>2</td>
</tr>
<tr>
<td>Base of 4th digit</td>
<td>1</td>
</tr>
<tr>
<td>Base of 5th digit</td>
<td>1</td>
</tr>
<tr>
<td>Base between 1st and 2nd digit</td>
<td>5</td>
</tr>
<tr>
<td>Palmar aspect of metacarpus</td>
<td>9</td>
</tr>
<tr>
<td>Dorsal aspect of metacarpus</td>
<td>1</td>
</tr>
<tr>
<td>Center of 1st digit</td>
<td>5</td>
</tr>
<tr>
<td>Center of 4th digit</td>
<td>1</td>
</tr>
<tr>
<td>Near cuff</td>
<td>6</td>
</tr>
</tbody>
</table>
these perforations occurred or what impact they would have on contamination. Some perforations also occurred on inner gloves with no perforation being detected on the outer glove. This could have occurred due to false negative results of the outer glove, shearing forces on the inner gloves that may have occurred in surgery or glove donning, or inherent glove defects.

One of the limitations of this study was glove storage after surgery. Ideally all gloves would have been tested immediately after surgery to prevent any post-operative perforations from occurring. Immediate testing was not feasible in our clinical setting; however, precautions were taken to avoid post-operative perforations. These precautions included careful glove handling, storage in plastic bags at room temperature, and testing before the expiration date stated by the manufacturer. These procedures were the same for both glove types and storage time before analysis did not differ significantly between groups. Another limitation of the current study is that these results only reflect the specific brands of gloves used and techniques described for 1 specific orthopedic procedure. As with any study, a failure to reject the null hypothesis can occur as a result of a type II error. In this study we were able to achieve our target sample size, which was calculated to allow us to detect a minimum difference of 10% between perforation rates. Though a difference in perforation rate less than 10% may have gone undetected, we chose this cut-off to represent a percentage difference that was clinically relevant and large enough to warrant recommendations about gloving procedures.

Eleven gloves were censored from the analysis, including 1 glove that was torn during removal. We elected to censor this glove as opposed to classify it as a perforation because the glove was torn during removal at the end of surgery and therefore did not represent a breach in asepsis. We did not find a significant difference in number of cases censored between groups; however, censoring of data can lead to bias in the results. Blinding surgeons and assistants to the type of glove used was not possible in our clinical setting and therefore remains a potential source of bias. However, due to the consequences of glove perforations surgeons generally make their best effort to avoid perforations regardless of preferred glove type. Use of the objective water leak test, rather than a subjective assessment, should minimize bias from the tester.

In conclusion, this study failed to detect a difference in perforation rate between double gloving with standard latex surgical gloves and orthopedic gloving in TPLO procedures. Double gloving was more cost effective than orthopedic gloving. There was no difference in unnoticed perforation rates between groups. As surgery time increased overall perforation rate and unnoticed perforations also increased. The authors recommend that surgeons should weigh the increased cost of orthopedic gloving versus comfort and personal preference when deciding which type of gloving to use.

Acknowledgments

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References

Validation of noninvasive hemoglobin measurements using co-oximetry in anesthetized dogs

Matt R. Read, Jenna Rondeau, Grace P.S. Kwong

Abstract — New technology allows noninvasive measurement of total hemoglobin (Hb) in humans through use of multiple wavelength co-oximetry. This monitor is now available to the veterinary market but no studies have been performed to validate its use in animals. This study investigated the use of co-oximetry to measure Hb in anesthetized dogs by comparing “gold standard” Hb measurements from a laboratory (LabHb) with those measured by the co-oximeter (SpHb). Bland-Altman analysis showed that the monitor had a bias of −3.01 (SpHb values were lower than LabHb values) and that 64.5% of measured SpHb values were greater than 20 g/L different from their associated LabHb values. Based on the results of this study, use of co-oximetry to measure Hb in anesthetized dogs is not accurate enough to direct treatment. Further studies are warranted in other animal species and under other clinical conditions.

Résumé — Validation des mesures non invasives de l’hémoglobine à l’aide de la co-oximétrie chez les chiens anesthésiés. La nouvelle technologie permet la mesure non invasive de l’hémoglobine totale (Hb) chez les humains à l’aide d’une co-oximétrie à longueurs d’onde multiples. Ce moniteur est maintenant disponible pour le marché vétérinaire, mais aucune étude n’a été réalisée pour valider son utilisation chez les animaux. Cette étude a évalué l’utilisation de la co-oximétrie pour mesurer Hb chez des chiens anesthésiés en comparant les mesures Hb d’un laboratoire (LabHb) considérées comme les mesures étalons aux mesures effectuées par le co-oximètre (SpHb). L’analyse Bland-Altman a montré que le moniteur avait un biais de −3,01 (les valeurs SpHb étaient inférieures aux valeurs LabHb) et que 64,5 % des valeurs SpHb mesurées présentaient une différence supérieure à 20 g/L par rapport aux valeurs LabHb correspondantes. En se fondant sur les résultats de cette étude, on constate que l’utilisation de co-oximétrie pour mesurer Hb chez les chiens anesthésiés n’est pas suffisamment exacte pour orienter le traitement. De nouvelles études sont justifiées chez d’autres espèces animales et dans d’autres conditions cliniques.

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Introduction

In red blood cells, oxygen molecules bind reversibly to hemoglobin (Hb), an iron-containing metalloprotein that is concentrated in the cells. If a patient develops conditions that result in anemia or low hemoglobin concentration, a blood transfusion may be required in order to maintain adequate delivery of oxygen to tissues.

Most veterinary patients that are presented to surgery or emergency services have blood samples collected in order to do a complete blood (cell) analysis, including measurement of hemoglobin levels. Laboratory measurement of hemoglobin (LabHb) is considered to be the gold standard for the measurement of hemoglobin concentration, and is a complex procedure that is typically performed with an automated analyzer in a clinical laboratory. Unfortunately, laboratory hemoglobin measurement is relatively invasive in that a blood sample is required. In addition, blood collection can be challenging in awake patients, and there is often a delay between blood collection and obtaining the results as a result of transporting the sample to the laboratory, validating the measurement, and returning the result to the person ordering the test.

In the case of an unstable patient, multiple blood samples may need to be collected and analyzed over the course of its hospital stay, which can be an issue since repeated testing is often limited by how much blood can be safely collected from small patients over a certain period of time. As well, by taking
a single blood sample, veterinarians are only informed about a patient’s hemoglobin level at 1 point in time, rather than as a continuous measurement. If there is a long delay between blood collection and analysis of the sample, the patient’s status may change (1). In cases in which ongoing blood losses are suspected or expected (e.g., during major surgery), the ability to continuously measure hemoglobin levels would potentially have a positive impact on patient care.

With recent developments in monitoring technology (Radical-7 Pulse CO-Oximeter, Masimo Corporation, Irvine, California, USA), the potential to noninvasively and continuously monitor a patient’s hemoglobin concentration has become possible, providing real-time access to the data without the need for collecting blood samples or analyzing them in a laboratory (2). The Masimo Radical-7 Pulse CO-Oximeter functions similar to a standard pulse oximeter and measures pulse rate and oxyhemoglobin saturation. However, this co-oximeter is uniquely able to emit multiple wavelengths of light in both the red and infrared spectrum in a pulsatile system to distinguish between and quantify the different types of hemoglobin. As a result, it is able to measure total hemoglobin (SpHb), carboxyhemoglobin, methemoglobin, and oxyhemoglobin, in addition to measuring other perfusion parameters such as perfusion index (PI) and plethysmograph variability index (3).

The Radical-7 Pulse CO-Oximeter is approved to measure noninvasive hemoglobin in humans with a reported difference of +/- 10 g/L from the standard laboratory values in adult patients with hemoglobin concentrations of 80 to 170 g/L (2,4). Studies have been performed to compare hemoglobin values obtained by the Radical-7 Pulse CO-Oximeter with those measured by laboratory equipment and have shown a clinically acceptable accuracy of noninvasive hemoglobin measurement in healthy adults. Its use is being increasingly reported in human medicine and surgery (1–9). To date, there are no published reports of the use or accuracy of this new technology in awake or anesthetized animals.

The aim of this prospective, observational study was to evaluate the reliability and accuracy between Radical-7 Pulse CO-Oximeter SpHb measurements and laboratory hemoglobin measurements (LabHb) in canine patients undergoing anesthesia, as a first step in ultimately determining the clinical utility of the monitor in this patient population. Secondary goals of the project included identifying patient and drug factors that affected the ability of the device to accurately measure noninvasive hemoglobin levels.

**Materials and methods**

This study was approved by the University of Calgary Veterinary Sciences Animal Care Committee (#AC14-0175). Dogs that were scheduled to undergo general anesthesia for elective surgical procedures at Western Veterinary Specialist and Emergency Centre (Calgary, Alberta) between November 2014 and February 2015 were enrolled in the study after obtaining informed and written owner consent. Routine demographic (age, gender, breed, weight) and procedure-specific data (procedure being performed, sedative and anesthetic drugs used, location of sensor placement) were collected for each patient. In order to select patients that were expected to have hemoglobin levels within the monitor’s validated range for humans (Hb = 80 to 170 g/L), patients that were known to be anemic based on previous diagnostic testing were not enrolled in this study.

Dogs were sedated and anesthetized using a variety of drug combinations at the discretion of the supervising veterinarians. In general, dogs were sedated with combinations of an opioid with or without acepromazine or dexmedetomidine, and they were induced using alfaxalone. Dogs were maintained under anesthesia using isoflurane in 100% oxygen using a non-rebreathing circuit and a precision out-of-circuit vaporizer. All dogs breathed spontaneously and were monitored using a combination of non-invasive oscillometric blood pressure measurement, lead-2 electrocardiography, and sidestream capnography during the period of data collection. The person collecting the data (JM or MR) was trained in the use of the co-oximeter device and was not the same person who was responsible for the direct clinical care of the patient. Once each dog was stable under anesthesia, a Rainbow® adhesive sensor (R1 25L. Adult Pulse CO-Oximeter sensor; Masimo Corporation, Irvine, California, USA) was placed on the dog’s tongue and kept in position using a standard pulse oximeter clip. The sensor was left in place for several minutes until the device obtained a stable measurement. If no reading was obtained at that location after 3 attempts, an additional 3 attempts were made at another location before reporting an undetectable reading. The person collecting the data made a reasonable effort to obtain a device reading, including repositioning the sensor on the tongue and on other accessible areas (e.g., paw, prepuce) and rechecking all connections as needed.

Once the readings had stabilized, the SpHb, SpO2, peripheral pulse rate, pulse index (PI), plethysmograph variability index (PVI), SpMetHb (level of methemoglobin), and co-oximeter derived oxygen content (SpOC) were recorded. The “signal strength” (SS) for the SpHb measurement (indicated by either a bright or a dim light) was also noted (“strong” versus “weak” respectively) for each dog. Immediately following successful noninvasive testing, a 3-mL venous blood sample was obtained from the dog’s jugular vein using a disposable syringe and then transferred to a vacuum tube containing ethylenediaminetetraacetic acid (EDTA) anticoagulant. Samples were transported at room temperature and analyzed for reference hemoglobin (LabHb) via a modified cyanmethemoglobin colorimetric method using a laboratory hematology analyzer (ADVIA 120; Siemens Healthcare GmbH, Germany) according to the manufacturer’s guidelines within 12 h of collection. The laboratory analyzer was calibrated daily as per the manufacturer’s recommendations and good laboratory practice. The hemoglobin concentration measured by the laboratory co-oximeter was used as the gold standard to compare the accuracy of SpHb measured by the Radical-7 Pulse CO-Oximeter. After the blood sample was collected, the Radical-7 Pulse CO-Oximeter was disconnected from each patient and the dogs were maintained under anesthesia for their scheduled procedures and recovered.

A Shapiro-Wilk test was performed to assess the normality of the continuous variables. Data are reported as mean and
standard deviation (SD) or, if normality assumptions failed, as median and interquartile range (IQR).

Graphic representation was performed using Bland and Altman plots to evaluate the bias, precision, and agreement of SpHb monitoring, taking the automated analysis in the lab (LabHb) as the reference, and the proportional bias and variation around the line of best agreement were studied (2,3,6,10,11). The number of SpHb readings within 0 to 10, 10 to 20, and > 20 g/L of LabHb measurements and the difference between LabHb and SpHb at each measured LabHb value were examined. Correlation coefficients were calculated to assess the associations between different variables. Pearson correlation coefficients were used for continuous variables unless the assumption of normality was violated in which case Spearman correlation coefficients were used instead. Point biserial correlation coefficients were used to assess associations between continuous and binary variables unless the assumption of normality was violated in which case rank biserial correlations were used instead. Statistical significance was set at \( P < 0.05 \) for all tests.

Results

Thirty-two dogs were enrolled in the study during the trial period. Anesthesia was uneventful for all of the dogs. Each dog underwent its scheduled procedure and recovered from anesthesia. The Radical-7 Pulse CO-Oximeter provided SpHb measurements in 31/32 dogs (96.9%). One dog was excluded from data analysis as a result of the monitor not being able to obtain an SpHb measurement despite multiple attempts at repositioning the sensor. Of the 31 dogs that were included in data analysis, 14 were male and 17 were female. The median (interquartile range) weight of the dogs was 31.5 kg (19.0 to 43.9 kg) and the median age was 6 y (2.75 to 8.25 y). Seventeen breeds were represented.

Fourteen dogs were sedated with a combination of acepromazine and hydromorphone, 14 dogs were sedated with dexmedetomidine and hydromorphone, 2 dogs were sedated using only hydromorphone, and 1 dog was sedated using fentanyl. Induction was achieved using alfaxalone in 28 dogs, propofol in 2 dogs, and a combination of ketamine and diazepam in 1 dog.

Thirty-one paired hemoglobin measurements were analyzed. The mean (± SD) values for LabHb and SpHb were 140.7 g/L (± 19.2 g/L) and 110.6 g/L (± 20.7 g/L) respectively. The mean (± SD) difference between measurements, 3.01 (± 2.32), was statistically significant and different from 0 \(( P < 0.0001)\). The difference between LabHb and SpHb was < 10 g/L in 6/31 (19.4%) patients, 10 to 20 g/L in 5/31 (16.1%) patients, and > 20 g/L in 20/31 (64.5%) patients.

More revealing was the Bland-Altman plot (Figure 1), the standard method for comparing a new test with an established test. The Bland-Altman plot showed that the Radical-7 Pulse CO-Oximeter underestimated LabHb by 30.1 g/L, with 95% limits of agreement (−1.55, 7.56). The negative slope around the mean difference was not statistically significant, indicating that the monitor’s bias was consistent across the range of measured values. Twenty-nine (93.5%) measurements fell within 2 SD of the mean difference.

A “strong signal” SpHb measurement was obtained in 11/31 dogs (35.5%). Weak correlations were found between LabHb-SpHb and SS (0.048), LabHb-SpHb and PI (0.29, differences in measured Hb were less when PI was greater), and PI and SS (0.18, signal strength was stronger when PI was higher). A moderate correlation was found between PI and the drugs that were used for sedation (0.51, PI was greater following use of acepromazine when compared to use of dexmedetomidine).

Discussion

The ability to accurately measure a patient’s hemoglobin level noninvasively using new pulse oximeter technology has great potential for small animal veterinary practice, especially in patients with small blood volumes and in clinics without in-house laboratory equipment. Monitoring SpHb in dogs and cats would provide immediate and clinically relevant information on which to base decisions, and would allow practitioners to follow trends and initiate medical interventions (e.g., blood transfusions) without the need for repeated blood sampling and expensive laboratory testing. Many studies have been conducted in humans to describe the use of this new technology, to document its accuracy and limitations, and to direct its use under a range of clinical conditions (1–9). To date, use of this technology to measure hemoglobin has not been reported in small animal species.

Several studies in humans have shown that there is good correlation between LabHb values and SpHb values, while others have shown it to be inaccurate (2). Many of the early studies used correlation coefficients to evaluate the performance of the monitor; however, this statistical test only indicates the degree to which 2 values have a linear relationship and does not reflect whether or not the relationship is clinically significant (2).
For this reason, more recent studies in humans and the study reported here used Bland-Altman plots to evaluate the degree of agreement between laboratory and monitor measurements, thereby highlighting any biases in the data (2–4,6–9). Recent investigations in humans that followed a similar research protocol to ours reported an average bias (mean difference between LabHb and SpHb) and precision (SD of paired differences) of $-1.9 \pm 17.1$ g/L (1,3,8,9).

The results of this study show that the Radical-7 Pulse CO-Oximeter does not perform as accurately in anesthetized dogs as it reportedly does in humans. The Bland-Altman difference plot for our data showed that there was not good agreement between the CO-Oximeter-derived hemoglobin (SpHb) and laboratory-measured hemoglobin (LabHb) across a range of values, and that the SpHb measurements obtained by the monitor were approximately 30 g/L lower on average than the corresponding laboratory measurements. The monitor used in this study did not consistently measure Hb, as demonstrated by the equal scattering above and below the mean difference reference line. The manufacturer reports an accuracy of $+/- 10$ g/L through a range of 80 to 170 g/L in adults and children (4). The differences between LabHb and SpHb in our study varied from $+83$ to $-15$ g/L, which would be clinically relevant and are outside the $+/- 10$ g/L range reported by Masimo when the monitor is used in humans. At this accuracy threshold, 80.6% of the readings in our study fell outside of this range.

The monitor failed to obtain an adequate SpHb signal in 11/31 dogs (signifying low monitor-confidence in the Hb readings 64.5% of the time). Similar findings have been reported in humans, but our results in anesthetized dogs were more pronounced (2). Our data also showed that only 35.5% of SpHb measurements were within 0 to 20 g/L of the gold standard laboratory values (LabHb). This is in contrast to previous reports in humans in which others noted that approximately 65% of SpHb readings were within 0 to 20 g/L of measured LabHb values (9).

Although it was not the primary goal of this study, the ability of the monitor to obtain a strong SpHb signal and to measure other important patient parameters such as pulse index was also investigated. Our data showed that there were no significant or clinically relevant correlations between LabHb-SpHb and the ability of the monitor to obtain a strong signal, individual SpHb and LabHb values and PI or signal strength, or between PI and signal strength. The only significant correlation that was clinically relevant was that higher PI values were found to be associated with use of acepromazine-based sedative protocols as opposed to dexmedetomidine-based protocols. This is likely due to the fact that acepromazine induces peripheral vasodilation and maintains cardiac output at a higher level under isoflurane anesthesia when compared to dexmedetomidine (12). In the presence of these contrasting cardiovascular effects, the differences between systolic and diastolic pressure and cardiac output would result in the greater PI values that were measured in the acepromazine-treated dogs in this study.

A “strong” SpHb measurement (indicated with a bright red color on the monitor) was acquired in only 11/31 (35.5%) dogs in this study, and the monitor was unable to obtain a reading in 1 dog. Previous studies in humans reported that the monitor was “unable to detect” in 2.6% to 30.0% of patients, despite multiple attempts at obtaining a reading (9). The correlations between SpHb and signal strength and LabHb-SpHb and signal strength were weak (0.15 and 0.048, respectively), suggesting that the accuracy of the Radical-7 Pulse CO-Oximeter was not affected by its ability to obtain a “strong” pulse signal from the patient. These findings also indicate that, even though pulse index was stronger in acepromazine-sedated patients, the use of sedative drugs with differing cardiovascular effects does not necessarily affect the ability of the monitor to accurately measure hemoglobin levels in anesthetized dogs. Further experience with this monitor in dogs may provide investigators and clinicians with more information on which to base its clinical use.

One of the strengths of this study is that it was performed under normal, clinical conditions. Other factors that can affect the monitor’s accuracy include patient movement, excessive ambient light, and electrical interference from nearby equipment. In our study, the dogs were maintained under general anesthesia during the period of data collection so patient movement was not a factor in the device producing a reading. Ambient light in the hospital was not excessive and, other than the patient being connected to a 3-lead electrocardiograph, electrical interference was not considered to be an issue in this study.

Further research is warranted before generalizable conclusions about the use of this monitor in small animal patients can be made. This study only investigated SpHb accuracy in anesthetized dogs, not in sedated or awake patients, we did not measure SpHb accuracy under motion or low perfusion states, and all measurements were taken by placing the Radical-7 Pulse CO-Oximeter sensor on the patient’s tongue, not other peripheral anatomical sites. Pulse oximeter probes are commonly placed on the tongues of anesthetized patients in order to measure oxyhemoglobin saturations and peripheral pulse rates and in most cases accurate $SpO_2$ readings are rapidly obtained. In awake patients, placement of pulse oximeter probes at this location is rarely feasible and as a result, use of the Radical-7 Pulse CO-Oximeter to obtain accurate SpHb measurements from other sites may be even more challenging.

Blood samples were collected immediately after the device obtained a single, stable SpHb reading and the value was recorded, rather than leaving the monitor in place for several minutes and averaging different SpHb readings before collecting the blood sample. Although we did not specifically record data that would denote if SpHb measurements fluctuated during the time it took to collect the blood samples, it is our clinical impression that the SpHb measurements did not change during this short period. The results of this study are limited to the specific conditions of this study and should not be extrapolated to other clinical situations. Other studies involving different species and larger sample sizes will need to be conducted to determine whether the lack of correlation and agreement of SpHb measurements persist in a diverse patient population over a range of clinical scenarios. Until this technology is more accurate in dogs, practitioners should, where appropriate, continue to use in-house hematocrit measurements and/or complete blood (cell)
counts as their primary methods for determining oxygen carrying capacity in their patients.

Reports of its use in humans have shown that the Radical-7 Pulse CO-Oximeter is not sufficiently precise to be used as the sole determinant of the need for blood transfusions. Instead, the monitor is used to follow trends in hemoglobin levels and to guide clinical decision-making regarding the timing of laboratory hemoglobin analysis. As a result, it may be able to spare patients from unnecessary blood collection and testing (9). Considering the results of this study, use of the monitor in clinical practice to follow trends and guide decisions about the timing blood sampling might be applicable to anesthetized dogs as well.

In summary, although the Radical-7 Pulse CO-Oximeter was reasonably easy to use, the device cannot be safely used to direct clinical decision-making (e.g., deciding when to transfuse a patient) regarding hemoglobin levels in anesthetized dogs. Our results showed that SpHb measurements obtained by the Radical-7 Pulse CO-Oximeter were consistency lower than the values determined by automated hemoglobin measurements. Our data are similar to those in recent studies in humans that show variable accuracy of the monitor under different clinical conditions. Although the monitor offers promise, the results of this study show that the current technology is not yet appropriate for widespread veterinary use.

Acknowledgments
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References
Antimicrobial resistance and beta-lactamase production of *Escherichia coli* causing canine urinary tract infections: Passive surveillance of laboratory isolates in Saskatoon, Canada, 2014

Rachel Courtice, Michelle Sniatynski, Joseph E. Rubin

Abstract — The antimicrobial susceptibility of canine urinary *Escherichia coli* (n = 113) isolated by a regional diagnostic laboratory over a 1-year period was determined. Antimicrobial minimum inhibitory concentrations were determined, and those isolates resistant to beta-lactams were screened for broad-spectrum beta-lactamas. Isolates were unexpectedly susceptible, 79.6% were susceptible to all drugs tested and no extended-spectrum beta-lactamases were identified. Our findings indicate that empiric treatment of canine urinary tract infections with first line drugs such as amoxicillin or trimethoprim + sulamethoxazole is likely to be successful.

*Escherichia coli* is a ubiquitous colonizer of dogs and the most common cause of canine urinary tract infections (UTI) (1). Treatment of UTIs includes the use of antimicrobials, among which the beta-lactams (penicillin type drugs) are the most commonly used in veterinary medicine (2). Historically *E. coli* from the Saskatoon region have been remarkably susceptible to antimicrobials, although a retrospective study identified increases in resistance among diagnostic isolates from 2002 to 2007 (1).

Emerging resistance to the beta-lactam antimicrobials is troubling; this diverse antimicrobial class includes the penicillins, cephalosporins, cefamycins, carbapenems, and monobactams, many of which are classified by Health Canada as of very high importance to human health (3). In *E. coli*, resistance to the beta-lactams most often results from the production of degradative enzymes, beta-lactamases (4). Broad-spectrum beta-lactamases, including the extended spectrum beta-lactamases (ESBLs) and the AmpC type enzymes (such as CMY-2), are especially concerning due to their ability to degrade 3rd generation cephalosporins such as ceftriaxone and cefotiofur (5). Since the mid 2000s the emergence of these enzymes among human clinical isolates in Canada has been dramatic. Between 2007 and 2011 the frequency of ESBL producing *E. coli* among human clinical isolates rose significantly from 3.4% to 7.1% with the CTX-M type enzymes dominating (6). In contrast, almost nothing is known about the occurrence of ESBL-producing *E. coli* in dogs in Canada (5). The only published Canadian (Ontario) study to date which screened dogs and cats, or their isolates for ESBLs, failed to identify these genes (7).

The purpose of this investigation was to describe the antimicrobial susceptibility profiles of *E. coli* grown from canine urinary samples by a regional diagnostic laboratory. Additionally, this investigation aimed to describe the presence of genes for broad-spectrum beta-lactamases among these isolates.

Over a 12-month period from October 2013 to 2014, all urinary *E. coli* isolated from dogs by Prairie Diagnostic Services in Saskatoon, Saskatchewan were saved for analysis. Urine samples submitted for analysis are routinely cultured on sheep’s blood and MacConkey agars; *E. coli* are identified based on colony morphology, lactose fermentation and the spot indole test. A total of 113 isolates were frozen at −80°C in tryptic soy broth plus 10% glycerol for future analysis. Antimicrobial
minimum inhibitory concentrations were determined by broth micro-dilution using the Sensititre system (Trek Diagnostics, Cleveland Ohio, USA). Ampicillin (AMP), amoxicillin plus clavulanate (AUG), cefoxitin (FOX), ceftiofur (TIO), ceftriaxone (AXO), tetracycline (TET), trimethoprim plus sulfamethoxazole (SXT), sulfisoxazole (SOX), chloramphenicol (CHL), nalidixic acid (NAL), ciprofloxacin (CIP), and gentamicin (GEN) were included on test panels. Testing was performed and interpreted in accordance with the manufacturer’s instructions and the Clinical and Laboratory Standards Institute guidelines (8,9). For quality control, E. coli ATCC 25922 and S. aureus 29213 were tested in parallel. Isolates resistant to amoxicillin plus clavulanic acid, ceftiofur or ceftriaxone were screened for CTX-M, SHV and TEM type ESBLs and group 2 CMY type β-lactamases by polymerase chain reaction (PCR) using previously published primers (10–13). Positive controls (organisms previously identified to possess each gene) and no template controls were included with each set of PCR reactions for quality control. Following PCR amplification, products were sent for sequencing to a commercial laboratory (Macrogen, Seoul, Korea) to identify the allele amplified.

Isolates were remarkably susceptible; the most common profile identified was pan-susceptibility detected in 90 (79.6%) isolates (Table 1). Resistance to ampicillin was most common, occurring in 10 (8.8%) isolates, followed by tetracycline, sulfisoxazole, and nalidixic acid which were each identified in 8 (7.1%) isolates (Table 2). Resistance to trimethoprim plus sulfamethoxazole was not detected. Resistance to all other drugs occurred in fewer than 5% of isolates. Six multidrug resistant isolates (resistant to 3 or more classes) were identified, including

### Table 1. Antimicrobial susceptibility profiles and β-lactamases identified from canine urinary E. coli isolates (n = 113) collected over 12 months (beginning in November, 2013) by a regional diagnostic laboratory in Saskatoon, Canada

<table>
<thead>
<tr>
<th>Phenotype</th>
<th>Number (%) isolates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pan-susceptible</td>
<td>90 (79.6%)</td>
</tr>
<tr>
<td>AMP</td>
<td>5 (4.4%)</td>
</tr>
<tr>
<td>SOX</td>
<td>3 (2.7%)</td>
</tr>
<tr>
<td>TET</td>
<td>3 (2.7%)</td>
</tr>
<tr>
<td>CHL</td>
<td>1 (0.9%)</td>
</tr>
<tr>
<td>NAL</td>
<td>1 (0.9%)</td>
</tr>
<tr>
<td>CHL + NAL</td>
<td>1 (0.9%)</td>
</tr>
<tr>
<td>NAL + SOX</td>
<td>1 (0.9%)</td>
</tr>
<tr>
<td>TET + NAL</td>
<td>1 (0.9%)</td>
</tr>
<tr>
<td>AMP + AUG</td>
<td>1 (0.9%)</td>
</tr>
<tr>
<td>AMP + NAL + GEN</td>
<td>1 (0.9%)</td>
</tr>
<tr>
<td>FOX + CHL + SOX</td>
<td>1 (0.9%)</td>
</tr>
<tr>
<td>AMP + TET + NAL + SOX</td>
<td>1 (0.9%)</td>
</tr>
<tr>
<td>FOX + CHL + TET + SOX</td>
<td>1 (0.9%)</td>
</tr>
<tr>
<td>AMP + FOX + AUG + AXO + TIO + TET + NAL + CIP</td>
<td>1 (0.9%)</td>
</tr>
<tr>
<td>AMP + FOX + AUG + AXO + TIO + TET + NAL + SOX + GEN</td>
<td>1 (0.9%)</td>
</tr>
</tbody>
</table>

* Isolate carried the CMY-2 type β-lactamase gene.

### Table 2. Minimum inhibitory concentration distribution of canine urinary E. coli isolates isolated over 12 months (beginning in November, 2013) by a regional diagnostic laboratory in Saskatoon, Canada

<table>
<thead>
<tr>
<th>Drug</th>
<th>0.015</th>
<th>0.03</th>
<th>0.06</th>
<th>0.12</th>
<th>0.25</th>
<th>0.5</th>
<th>1</th>
<th>2</th>
<th>4</th>
<th>8</th>
<th>16</th>
<th>32</th>
<th>64</th>
<th>128</th>
<th>256</th>
<th>512</th>
<th>% R</th>
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<tbody>
<tr>
<td>AMP</td>
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<td>10</td>
<td>1</td>
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<td>TIO</td>
<td></td>
<td>1</td>
<td>13</td>
<td>78</td>
<td>19</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>1.8</td>
</tr>
<tr>
<td>AXO</td>
<td>107</td>
<td>1</td>
<td>3</td>
<td>65</td>
<td>24</td>
<td>6</td>
<td>2</td>
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</tr>
<tr>
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<td></td>
<td></td>
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<td>25</td>
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<td>107</td>
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<td>64</td>
<td>12</td>
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<td></td>
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<td>0</td>
</tr>
<tr>
<td>SXT</td>
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<td>67</td>
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<td>8</td>
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<tr>
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<td></td>
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<td>7.1</td>
</tr>
<tr>
<td>CIP</td>
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<td>29</td>
<td>1</td>
<td>4</td>
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<td>1</td>
<td>1</td>
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<td>1.8</td>
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Antimicrobial minimum inhibitory concentration (MIC) distribution for E. coli isolates (n = 113) for ampicillin (AMP), cefoxin (TIO), ceftriaxone (AXO), amoxicillin plus clavulanic acid 2:1 (AUG), cefoxitin (FOX), tetracycline (TET), chloramphenicol (CHL), sulfisoxazole (SOX), trimethoprim plus sulfamethoxazole 1:19 (SXT), gentamicin (GEN), nalidixic acid (NAL), and ciprofloxacin (CIP). Cells corresponding to concentrations tested are white and resistance breakpoints are denoted by dark bars. The number of isolates inhibited at each concentration are noted in each cell, isolates not inhibited by the highest concentration of each drug are enumerated in the first concentration above the highest concentration tested.
1 resistant to the β-lactams, tetracycline, nalidixic acid, and ciprofloxacin and another resistant to the β-lactams, tetracycline, nalidixic acid, sulfisoxazole, and gentamicin. Both of these isolates carried the CMY-2 gene, an AmpC type β-lactamase which confers resistance to 3rd generation cephalosporins, potentiated penicillins, and cefoxitin (5). No ESBLs were detected.

The findings of this study indicate that antimicrobial resistance is not common among canine *E. coli* in our region, and that first line drugs such as amoxicillin are likely to be effective empiric therapeutic options. Although relatively few data are available, the frequency of resistance identified in this investigation is very low compared to other regions (5,14). A recent, multi-regional study in the United States conducted between 2008 and 2013 identified higher rates of resistance to ampicillin, amoxicillin plus clavulenate, trimethoprim plus sulfamethoxazole, chloramphenicol, and ciprofloxacin than were found in the present investigation (14). Globally, companion animal infections with *E. coli* producing ESBLs and CMY-2 type β-lactamases have been reported from similar studies of diagnostic isolates in Europe and the United States (5). Perhaps most alarmingly was the recent description of *E. coli* producing the NDM-1 carbapenemase isolated from 5 dogs and 1 cat (including 4 urinary isolates) in the United States (15).

We aim to continue our surveillance activities to detect the emergence of resistance, and provide timely local data to practitioners to facilitate the evidence-based use of antimicrobials. Furthermore, we believe there would be great value in the development of a harmonized resistance surveillance strategy targeting companion animal pathogens including urinary *E. coli*. We encourage the veterinary diagnostic community to pursue such collaborative efforts. Consistent with descriptions of increasing resistance among human *E. coli* isolates, we anticipate identifying an increasing frequency of broad-spectrum β-lactamases among canine urinary isolates. Although resistance was infrequently identified, we stress the importance of culture and susceptibility testing to ensure that antimicrobial therapy is evidence-based in line with diagnostic and therapeutic best practices (16).

**Acknowledgments**

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Attempted ultrasound-guided ethanol ablation of a suspected pancreatic pseudocyst in a dog

Ryan A. Sadler, Erica L. Fields, Jacqueline C. Whittemore

Abstract — A 9-year-old, spayed female toy poodle dog developed refractory anorexia after pancreatitis. Abdominal imaging showed a cystic structure compressing the stomach. Appetite improved after percutaneous drainage of the structure, but the structure refilled within 48 h. Percutaneous ethanol ablation of the structure was attempted. Afterwards, the patient developed fatal hypotensive shock.

Résumé — Tentative d’ablation à l’éthanol par échographie guidée pour un pseudokyste pancréatique suspecté chez un chien. Une chienne caniche stérilisée âgée de 9 ans a développé une anorexie refractaire après une pancréatite. L’imagerie abdominale a montré une structure kystique comprimant l’estomac. L’appétit s’est amélioré après un drainage percutané de la structure, mais la structure s’est remplie de nouveau dans un délai de 48 heures. On a réalisé une tentative d’ablation à l’éthanol percutanée de la structure. Après l’intervention, le patient a développé un choc hypotensif mortel.

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A 9-year-old, spayed female toy poodle dog, with a 3-year history of intermittent pancreatitis, was initially presented to the primary veterinarian after multiple episodes of vomiting, soft stool, and lethargy following dietary indiscretion. Prior episodes of pancreatitis had been treated with supportive care, and the patient had been maintained on a duck and potato diet (d/d Canine Skin Support Potato & Duck Formula; Hill’s Pet Nutrition, Topeka, Kansas, USA). The patient had a 6- to 8-month history of seizures that were well-controlled by phenobarbital, 2 mg/kg body weight (BW), PO, q12h. Pertinent physical examination findings reported by the referring veterinarian included a markedly tense and painful abdomen on palpation. Blood abnormalities included hemoconcentration (packed cell volume 70%), hypoglycemia [3 mmol/L, reference interval (RI): 3.9 to 7.9 mmol/L], hypocalcemia (1.4 mmol/L, RI: 2.3 to 2.9 mmol/L), hyperglobulinemia (53 g/L, RI: 25 to 45 g/L), hyperbilirubinemia (23.9 μmol/L, RI: 0 to 15.4 μmol/L), and increased alkaline phosphatase (545 U/L, RI: 23 to 212 U/L), alanine aminotransferase (218 U/L, RI: 10 to 100 U/L), amylase (1803 U/L, RI: 500 to 1500 U/L) and lipase (3591 U/L, RI: 200 to 1800 U/L) activities. A complete blood (cell) count (CBC) was not obtained, but blood smear evaluation was consistent with neutrophilia with a left shift. Generalized decreased serosal detail was noted on abdominal radiographs. Initial management included hospitalization with IV crystalloid fluids, enrofloxacin, maropitant, famotidine, and buprenorphine. Water and food were withheld. The patient had minimal improvement after 2 d and was referred to the University of Tennessee Veterinary Medical Center (UTVMC) for evaluation.

Case description

On presentation to the UTVMC, physical examination findings included a markedly tense and painful abdomen with a pain score of 9/10 (1), moderate lethargy, moderately tacky mucous membranes, a II/VI left-sided systolic murmur, and soft brown feces on rectal examination. Abnormalities on plasma biochemistry profile included hypoproteinemia (53 g/L, RI: 54 to 68 g/L), hypoalbuminemia (19 g/L, RI: 32 to 41 g/L), hyperglobulinemia (34 g/L, RI: 20 to 32 g/L), hypocalcemia (2.1 mmol/L, RI: 2.5 to 3.0 mmol/L), elevated alkaline phosphatase activity (217 U/L, RI: 15 to 164 U/L), elevated aspartate aminotransferase activity (54 U/L, RI: 15 to 51 U/L), and hypercholesterolemia (9.6 mmol/L, RI: 3.8 to 8.7 mmol/L). Urinalysis was unremarkable except for isosthenuria. On CBC, mature neutrophils were within the RI, but there was a slight increase in band neutrophils (360/μL, RI: 0 to 300/μL), and 2+ toxic change was noted.

Abdominal imaging was performed at the time of admission to the UTVMC and reviewed by a board-certified radiologist.
were no significant changes in sodium, potassium, phosphorus, during abdominal palpation, but she remained anorexic. There showed no interest in eating.

St. Charles, Missouri, USA) was offered periodically, but the dog PO, q12h, and general supportive care. A bland, low-fat diet tant (Cerenia; Pfizer Animal Health, New York, New York, Animal Health), 20 mL/kg BW per day, fluid therapy, maropip-

4 to 5 mL/kg BW per hour, and colloid (Vetstarch; Abbott Animal Health), 0.03 to 0.1 mg/kg BW , IV , and a propofol CRI (Propoflo; Abbott Laboratories, USP; West-ward, Eatontown, New Jersey, USA), 0.2 mg/kg BW , IV , midazolam (Midazolam Injection, Zoetis, Florham Park, New Jersey, USA). The patient was placed on a CRI liquid diet (Perative; Abbott Animal Health) through the feeding tube at a third of its total energy requirement. The infusion rate was increased over 72 h to meet the dog’s resting energy requirement.

After 72 h, the patient had a pain score of 3/10 during abdominal palpation, but a slight mass effect was palpable in the cranial abdomen. The patient remained hypoxic, in spite of discontinuation of tube feeding and reduction in the rate of the fentanyl and lidocaine CRI to assess for dysphoria. On repeat abdominal ultrasound, there was recurrence of the pancreatic cystic structure, contiguous with the body of the pancreas and extending from approximately midline toward the left side of the patient, following along the wall of the gastric fundus. It measured 5.4 cm × 2.8 cm and was unchanged in appearance from the initial examination (prior to drainage) except for increased internal septation. There was also a hypoechoic and enlarged pancreatic body and right limb, persistently hypoechoic mesentery, corrugation of the duodenum, and a small volume of nearly anechoic effusion.

Based on persistent hyporexia and the rapid recurrence of the pancreatic cystic structure, a computed tomography (CT) scan (Brilliance 40-channel multidetector CT; Philips Healthcare, Andover, Massachusetts, USA) of the abdomen was recommended to assess the possibility of surgical correction of the cystic lesion. The patient was sedated with butorphanol (Torbugesic; Zoetis, Florham Park, New Jersey, USA), 0.4 mg/kg BW, IV, midazolam (Midazolam Injection, USP; West-ward, Eatontown, New Jersey, USA), 0.2 mg/kg BW, IV, and a propofol CRI (Propoflo; Abbott Laboratories, North Chicago, Illinois, USA), 0.03 to 0.1 mg/kg BW per minute. Heart rate, indirect blood pressure, respiratory rate, and temperature were monitored every 5 to 10 min throughout the procedure. Findings on CT scan before and after contrast (Optiray 350; Tyco Healthcare, Hazelwood, Missouri, USA) included a large, multicavitary cystic structure surrounding the body and left lobe of the pancreas and causing compression.
and displacement of the stomach (Figures 2 and 3). Due to
the location of the cystic structure and the amount of pancreas
involved, subtotal pancreatectomy with cholecystoduodenos-
tomy would have been required to achieve surgical excision of
the cystic structure. Given the size of the structure and presence
of multiple septations, the surgery service recommended against
omentalization.

Percutaneous ethanol ablation of hepatic and renal cysts
has been performed without incident in dogs and cats at the
UTVMC, and ethanol ablation is increasingly used for ablation
of pancreatic pseudocysts in humans (3). Therefore, consider-
ation was given to the possibility of performing ethanol ablation
of the dog’s cystic lesion, given the degree of gastric compres-
sion, persistent anorexia, and high morbidity associated with
possible surgical procedures. Results of the CT scan and surgical
consultation, as well as the lack of data on ultrasound-guided
ethanol ablation in dogs and, thus, the possibility of severe
complications were discussed with the owners. The owners
were offered the alternative options of surgery and continuing hos-
pitalization for supportive care and supplemental nutrition, in
hopes that the dog would begin eating on its own. The owners
elected to pursue ethanol ablation.

The dog was transported to the ultrasound suite, and sedation
was continued using the previously described propofol CRI.
Abdominal ultrasound of the cranial abdomen was repeated
by a board-certified radiologist (ELF) to locate the cystic
structure. Per hospital protocol, ethanol (Alcohol 190-proof;
Decon Labs, King of Prussia, Pennsylvania, USA) from a pre-
viously unopened bottle was used to make 80% ethanol for
the ablation. The skin over the area was aseptically prepared,
and ethanol ablation was attempted by the radiologist. Using
a 22-gauge, 3.8-cm needle attached to sterile tubing, a 3-way
stopcock, and a 35-mL syringe, 18 mL of straw-colored fluid
was drained from the cystic structure, resulting in its collapse,
and then 18 mL of 80% ethanol was instilled. The ethanol was
left in place for 5 min, after which 15 mL of nearly clear fluid
was removed from the structure, again resulting in its collapse;
then, 15 mL 80% ethanol was again instilled. After the second
infusion, only 3 mL of clear fluid was successfully recovered,
despite multiple attempts at redirecting the needle within the
cystic structure, which did not collapse inward as it had with
the previous 2 drainages. There was no evidence of increased
peritoneal fluid in the area surrounding the pancreas, although
leakage could not be definitively ruled out given the presence
of peritoneal effusion around the pancreas prior to the ablation
procedure. Based on these findings, it was considered most likely
that septations within the cystic structure were preventing fur-
ther fluid recovery. Based on the length of time elapsed (75 min)
and the inability to recover additional fluid from within the
cystic structure, the procedure was terminated.

The patient was returned to the intensive care unit for
recovery. A single dose of ampicillin/sulbactam (Novaplus;
West ward), 30 mg/kg BW, IV, was given 30 min after the
procedure during the recovery period. After discontinua-
tion of sedation, the patient remained moderately obtunded
in spite of stable vital parameters (indirect Doppler systolic
blood pressure > 90 mmHg, temperature > 37.7°C, heart
rate > 80 beats/min, respiratory rate > 20 breaths/min).
Approximately 3 h after discontinuation of sedation, the patient
became progressively unresponsive with absent corneal and
palpebral reflexes. The patient was hypothermic (35.7°C),
tachycardic (> 190 beats/min), had increased respiratory effort,
and had an undetectable systolic blood pressure using either
Doppler sphygmomanometry or oscillometry. There were no

Figure 2. Transverse post-contrast CT image showing cross-
sectional view of right kidney (A), right pancreatic lobe (B),
pancreatic cystic structure (C), and stomach (D) of a dog with
pancreatitis. The gastric rugae are thickened, and the stomach is
displaced to the left of the abdomen (right side of the figure) by
the pancreatic cystic structure.

Figure 3. Dorsal plane CT image showing the descending
duodenum (arrow), pancreas (A), pancreatic cystic structure (B),
and stomach (arrowhead) in a dog with pancreatitis. Note that
the cyst appears to lie cranial and caudal to the left pancreatic
lobe, and the stomach wall is thickened and cranially displaced.
significant findings on venous blood gas and blood glucose analysis. Echocardiogram to assess myocardial function was not performed due to the patient's critical state, but there was no evidence of myocardial dysfunction on electrocardiogram.

Continuous telemetry was initiated, and fluid resuscitation procedures were performed in a stepwise manner over a 3-hour period, including boluses of IV colloid (Vetstarch; Abbott Animal Health), 4 mL/kg BW then continued at 1.2 mL/kg BW per hour, hypertonic saline, 5 mL/kg BW slowly, and crystallloid (Plasma-Lyte; Abbott Animal Health), 15 mL/kg BW then continued at 4 mL/kg BW per hour fluids. The patient’s systolic blood pressure transiently improved to 100 mmHg after each intervention before declining to 70 mmHg on Doppler flow measurements. Temperature increased to 37.5°C using supplementary heating (Hot Dog; Augustine Biomedical and Design, Eden Prairie, Minnesota, USA), but there was no improvement of mental status. Anisocoria developed 4 h after resuscitation was initiated, and mannitol (Mannitol Injection, USP 25%; APP Pharmaceuticals, Schaumburg, Illinois, USA), 1 g/kg BW, IV, was given over 20 min. Although the patient remained minimally responsive, abdominal palpation elicited marked pain. A fentanyl bolus (5 μg/kg BW, IV) was given, and the fentanyl and lidocaine CRIs were restarted at rates of 5 μg/kg BW per hour and 2 mg/kg BW per hour, respectively. Diphenhydradmine (Diphenhydramine HCl Injection; Westward), 2 mg/kg BW, IM, and dexamethasone (Dexamethasone Injection; VetOne, Boise, Idaho, USA), 0.5 mg/kg BW, IV were administered, and another bolus of hypertonic saline (5 mL/kg BW, IV) was given slowly. Dobutamine (Dobutamine Injection, USP; Hospira, Lake Forest, Illinois, USA), 5 μg/kg BW per minute and ketamine (Zetamine; VetOne), 5 mg/kg BW per hour, and then dopamine (Dopamine Hydrochloride Injection, USP; Hospira), 5 μg/kg BW per minute, CRIs were administered, resulting in transient stabilization of the systolic blood pressure. The patient began vocalizing intractably with concurrent progressive bradycardia and refractory hypotension. Agonal breathing patterns were noted, and atropine (Atropine Sulfate; VetOne), 0.1 mL/kg BW, IV, and epinephrine (Epinephrine Injection, USP; Amphastar Pharmaceuticals, Rancho Cucamonga, California, USA), 0.01 mL/kg BW, IV, were given with minimal response. Due to the poor prognosis, the owners elected euthanasia with 3 mL pentobarbital (Fatal-Plus Solution; Vortech Pharmaceuticals, Dearborn, Michigan, USA), IV. The owners declined necropsy.

**Discussion**

This report describes refractory hypotensive shock and death after ethanol infusion of a pancreatic cystic structure in a dog. Potential causes for severe, unresponsive hypotension following ethanol injection include release of bradykinin and other inflammatory mediators, ethanol intoxication, lysis of a cystic neoplasm, allergic reaction, a reaction to anesthetic medication, and/or sepsis.

Pancreatic cystic lesions can be divided into congenital pancreatic cysts, retention cysts, pseudocysts, abscesses, cystic neoplasms, and loculated effusions (4–6). Congenital pancreatic cysts, distinguished by the presence of epithelial linings on histology, occur quite rarely in humans. Such cysts are typically small and present in multiples throughout the pancreas in association with cystic disease in other organs. In humans, the presence of a large solitary cystic lesion in association with pancreatitis is considered adequate to rule out a congenital cyst (4). Retention cysts, dilatations of the pancreatic ducts secondary to ductular obstruction, can occur in association with chronic pancreatitis, among other causes. They are generally characterized by the presence of small accumulations of fluid, however, in association with ductular obstruction (5). Given the presence of clinical and ultrasonographic signs of acute pancreatitis and the presence of a very large solitary cystic lesion without evidence of pancreatic ductular obstruction in this case, these differentials were excluded from further consideration.

The major differentials for large cystic lesions within the pancreas in patients with clinical signs of pancreatitis, such as was seen in this case, are pancreatic pseudocyst, abscess, cystic neoplasia, and loculated effusion (6). Pancreatic pseudocysts are collections of pancreatic secretions and cellular debris enclosed within fibrous sacs that lack epithelial walls (2,3). Development of pseudocysts can occur secondary to pancreatitis and pancreatic trauma; in humans, pseudocysts are the most common cystic lesion of the pancreas (7,8). Differentiation is generally based on the results of cytologic evaluation of the cystic fluid, as well as comparison of pancreatic enzyme activity in the cystic fluid and serum/plasma (2,6). In humans, enzyme activities are most commonly low in fluid from cystic neoplasms, while high amylase and lipase activities in fluid are consistent with pseudocyst formation (9). Higher amylase and lipase activities were found in cystic fluid versus serum for 5/6 dogs and cats with pancreatic pseudocysts in 1 report (2). The sixth animal also had high pancreatic enzyme activities in the cystic fluid, but serum activities were not measured. One dog in that report had similar amylase activities on fluid versus serum, and the magnitude of activity increased greater for lipase than amylase. Based on these findings, the authors postulated that lipase activities might be more helpful than amylase activities for diagnosis of pancreatic pseudocysts in animals. The dog reported herein, however, had much higher amylase activities in its cystic fluid than in plasma, while differences in lipase activity were small. Simultaneous measurement of both amylase and lipase in fluid from pancreatic cystic lesions in dogs, therefore, seems prudent. Finally, the importance of clinical and radiologic judgment in achieving an accurate diagnosis should not be overlooked. In 1 prospective study in humans, clinical and radiologic judgment were more accurate than fluid enzyme activities in differentiating pseudocysts from cystic neoplasia (9).

Pancreatic pseudocysts have been treated in dogs by percutaneous drainage, cystogastrostomy, surgical omentalization, and surgical debridement (2,10–14). These treatments vary in invasiveness and cost; potential problems include pancreatitis, recurrence, septic peritonitis, and perioperative complications such as hemorrhage and reactions to anesthetics. In humans, endoscopic ultrasound- (EUS-) guided ethanol ablation has recently supplanted surgical correction of pseudocysts (3,15,16). Complications of EUS-guided ethanol ablation in humans include abdominal pain, acute pancreatitis, fever, pericystic
spillage, and splenic obliteration, though adverse events occur in only 0.7% to 7.9% of patients (3). Using EUS-guided ethanol ablation, complete resolution has been reported in 35% to 75% of humans with pancreatic pseudocysts (3).

Percutaneous ethanol ablation has been reported for successful treatment of hepatic and renal cysts in dogs and cats (17). In 1 retrospective study, 95% ethanol was infused via ultrasound guidance after cyst drainage for both renal (10 animals) and hepatic (12 animals) cysts; 13.6% (3/22) of animals had minor complications such as hemorrhage, abdominal discomfort, vomiting, and anorexia (17). These complications resolved after 3 to 4 wk. Neither hypotension nor other serious complications occurred in any of these cases.

Although ethanol toxicity in dogs has been infrequently reported, the oral lethal dose is thought to be 5 to 8 g/kg BW (18,19). Clinical signs after toxic ingestion include central nervous system depression, behavioral changes, ataxia, hypothermia, and cardiac or respiratory arrest (18,19). Less is known about parenteral ethanol toxicity, but the IV lethal dose of ethanol was 9.6 g/kg BW in 1 experimental study of ethanol poisoning in dogs (20). Lethal IV injection was associated with an increase in blood pressure for 3 h, followed by a slight decrease in pressure prior to cardiac failure and arrest at 4 h. Other findings included hyperglycemia and tachycardia (20). Although redirection of the needle in the case described herein could have resulted in leakage of ethanol into the peritoneal space and more rapid absorption into the blood stream than would be anticipated from a pseudocyst, the 12 mL ethanol that was not recovered from this patient equals a 2 g/kg BW dose, approximately 20% of the previously determined lethal IV dose. Treatment for ethanol toxicity includes supportive care and decontamination, although hemodialysis could improve recovery (17). The fulminating onset and severity of clinical signs, lack of hyperglycemia, and low ethanol dose make ethanol intoxication an unlikely mechanism for this patient's rapid decline. Use of lidocaine and fentanyl for analgesia possibly contributed to the patient's overall decline.

In 1 study, hypotension occurred in association with experimentally induced pancreatitis in dogs as a result of bradykinin and beta-endorphins, which can affect myocardial function; bradykinin antagonists improved survival in those dogs (21). Bradykinin and beta-endorphins can have a profound effect on blood pressure and survival during acute pancreatitis, and manipulation of the cystic structure in this case could have contributed to their release and subsequent refractory hypotension. There was no evidence of myocardial dysfunction on electrocardiogram, but full cardiac evaluation was not pursued due to the patient's marked instability. Although serum bradykinin levels were not measured in this patient, it is possible that high bradykinin concentrations could have contributed to the patient's rapid decline. Use of lidocaine and fentanyl CRIs in this dog might have decreased the impact of potential bradykinin release in this case because of lidocaine’s inhibitory effects on bradykinin receptors and fentanyl’s cardioprotective effects (22,23).

Another possibility for the patient’s hypotensive shock and death could be the development of a pancreatic abscess, either through introduction of bacteria during initial aspiration of the cystic structure or by release of infectious material during the ablation attempt. Although broad-spectrum antibiotics were started shortly after the ablation, similar to the protocol used in humans (16), the antibiotics could have been inadequate to prevent hypotensive septic shock, depending on the bacterial load present and time to onset of action. No clinical signs associated with an infectious process, such as fever or hypothermia, were present prior to the ablation procedure. Because cultures of the pancreatic fluid and abdominal fluid were not performed and the owners declined necropsy, this possible complication cannot be fully ruled out.

Tumor lysis syndrome, which has been described in humans during surgical manipulation of a neoplastic mass, can result in significant electrolyte changes and marked decline in condition during the intraoperative period (24). However, tumor lysis syndrome is associated with significant concomitant bradycardia and intravascular hemolysis (24), which were not present in this patient. Because postmortem analysis was declined, cystic neoplasia cannot be definitively ruled out, although enzyme activities were more consistent with pseudocyst formation. Regardless, although electrolytes were not measured at the time of decompensation, the lack of electrocardiogram changes and/or hemolysis in this patient is not consistent with tumor lysis syndrome.

Propofol infusions can also decrease myocardial contraction and systemic blood pressure in dogs (25). Propofol’s effects in dogs are relatively short-lived due to rapid redistribution, and refractory hypotension despite resuscitation procedures has not been reported for propofol alone. In this patient, blood pressure remained within the RI during propofol administration at a relatively low infusion rate (0.03 to 0.1 mg/kg BW per minute) and immediately after its discontinuation.

Unfortunately, the exact cause of this patient’s decompensation cannot fully be determined. The patient’s severe hypotensive episode was likely multifactorial given the extent and prolonged course of its disease, possible mild ethanol intoxication, and receipt of hypotension-inducing drugs. To the authors’ knowledge, this is the first report of percutaneous ultrasound-guided ethanol ablation of a suspected pancreatic pseudocyst in a dog. Fatal complications occurred that could have been the result of the procedure. Prospective studies are warranted to determine the safety of ultrasound-guided ethanol ablation for pancreatic cystic structure correction before it can be recommended for clinical use in dogs.

References

VEEN Available for Veterinarians

VEEN (Vet Equipment Exchange Network) is a website and on-site service that makes it possible for veterinarians to resell surplus equipment to other veterinarians. Canmedical has been in business for over 30 years and has connections with veterinarians all over Canada that either want to sell something or want to buy something that is used. All equipment is sold "as is where is". There is no warranty, but the buyer and the seller can communicate directly with one another and on-site inspections of equipment can be arranged. If the equipment that is for sale is in need of repair, Canmedical can arrange for the repairs to be done to make the equipment usable. This service has the potential to offer huge cost saving for veterinarians.

Contact: Bob Simpson, Canmedical, Vet Equipment Exchange Network (VEEN), phone: (613) 358-5658; websites: www.canmedical.ca and www.veencanada.com

Canadian Regulator-Approved Immunotherapeutic Available for Equine Sarcoid Tumors

NovaVive Inc., a Canadian immunobiology company, is pleased to announce that it has United States department of Agriculture (USDA) and Canadian Food Inspection Agency (CFIA) approval for Immunocidin® to treat equine sarcoid tumors. The Company believes that there is no other regulator approved equine sarcoid therapy in North America.

Equine sarcoids are locally aggressive fibroblastic neoplasms considered to be the most common skin tumors of horses worldwide. They are often found around the eyes, head/face, neck, chest, and shoulder, and also at the site of old scars. Young to middle-aged horses are most commonly affected by sarcoid tumors.

Current treatment options include surgery, ligation, cryotherapy, topical treatment, chemotherapy, radiation therapy, or laser removal; many of these treatments incur side effects. Immunotherapy is a new, safe and effective treatment option.

Immunocidin is administered by intratumoral injection, but the response is generalized and untreated sites frequently undergo regression as well.

“There are many good reasons to use Immunocidin for equine sarcoids,” said Dr. Stan Alkemade, Chief Veterinary Scientific Officer at NovaVive Inc. “It has a high post-treatment tumor-free rate, is well-tolerated by horses, including older animals, has minimal side effects and an excellent safety profile, and it is an economical treatment option.”

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Case Report Rapport de cas

Disseminated yeast (Order Saccharomycetales) infection in a Muscovy duckling (Cairina moschata)

Madhu Ravi, Janet E. Hill, Champika Fernando, Gary Wobeser

Abstract — A Muscovy duckling was presented for necropsy due to ongoing mortalities on a farm. Microscopic examination revealed multisystemic inflammatory lesions with intralesional and intracytoplasmic yeast-like organisms. We identified these agents as yeast belonging to the Order Saccharomycetales based on sequence data obtained from the ribosomal RNA operon.

Mortalities associated with numerous intracellular organisms in the capillary endothelial cells of different body systems in Muscovy (Cairina moschata) and domestic (Anas platyrhynchos domestica) ducks have been reported from Canada and the United Kingdom, but the identity of these organisms and their classification remains undetermined (1,2). Previous studies described these intracellular organisms in Muscovy duck disease as protozoa (3), probably bacteria capable of forming spores (2), and, most recently, unusual intracellular periodic acid–Schiff (PAS) positive budding organisms (1). Recently, morphologically similar organisms were observed in the tissues of a blue heron and identified as yeast belonging to the Order Saccharomycetales (4). Here, we report a case of disseminated infection and associated pathological lesions in a Muscovy duckling with similar intracellular organisms identified as yeast belonging to the Order Saccharomycetales.

Case description

A 2-month-old farm-raised Muscovy duckling was submitted for necropsy by a referring veterinarian to the pathology laboratory of Alberta Agriculture and Forestry in Edmonton. The duckling was part of a group of 11 birds hatched in early August 2013, some of which may have been hybrid Muscovy/Indian Runner ducks. Approximately 1 wk after hatching, the ducklings were relocated to a large open slough on the farm. Six ducklings died during September and October before they were fully fledged. Clinical signs included acute illness with lethargy and rapid progression to death. The referring veterinarian performed a postmortem examination on 1 dead bird, found no significant gross lesions and conducted no further tests. Due to ongoing mortality, a fresh dead duckling was submitted for diagnostic investigation, and was found to be in good body condition with diffusely congested and edematous lungs and spleen that was enlarged nearly 2 times the normal size.

Portions of brain, heart, trachea, lungs, liver, spleen, kidneys, small and large intestines, and sciatic nerves were fixed in 10% neutral buffered formalin. Tissue specimens were processed routinely for histology, and 5-μm thick sections were stained with hematoxylin and eosin (H&E). Histologically, there was a severe, non-suppurative interstitial pneumonia with clusters of round to oval, slightly basophilic intracellular organisms measuring approximately 2 μm × 0.5 to 1.0 μm in the cytoplasm of blood capillary endothelial cells and macrophages in the atrial septa which connect the atrial lumens with the parabronchial lumens (Figure 1A). Air capillary interstitium was expanded and infiltrated with small numbers of lymphocytes, plasma cells, and macrophages. Para-bronchi and atria were filled with eosinophilic proteinaceous edema. Intracellular organisms in endothelial cells and macrophages with similar inflammatory...
infiltrate were also present in the tracheal mucosa, interstitium of myocardium, exocrine pancreas, spleen, mucosa and submucosa of the small intestine, choroid plexus (Figure 1B) and sciatic nerve (Figure 1C).

To further characterize the morphology of intracellular organisms, Periodic acid-Schiff (PAS), Ziehl–Neelsen (ZN) acid-fast, modified Brown and Brenn (BB) Gram stain and Grocott’s methenamine silver (GMS) stained sections were prepared from paraffin-embedded formalin-fixed lung tissues. The intracytoplasmic organisms had weak Gram-negative staining. The cell walls of the intracellular organisms stained positively with PAS stain indicating the presence of glycogen as seen in fungi, and did not stain with ZN. The GMS stain revealed argyrophilic, intracytoplasmic, budding, yeast-like organisms (Figure 1D).

Routine bacterial culture on liver and spleen, and polymerase chain reaction (PCR) testing for avian influenza (AI) matrix and avianparamyxovirus-1 (APMV-1) were performed on tracheal tissue. No attempt at fungal culture was made at the time. The PCR testing for AI and APMV-1 was negative and bacterial culture results were considered to be not significant.

DNA was extracted from formalin-fixed paraffin-embedded lung tissue using a commercial kit (QIAamp DNA FFPE Tissue Kit; Qiagen, Mississauga, Ontario). The PCR reactions were performed using primers designed to amplify a segment of the rRNA operon of the uncultured yeast previously detected in lung tissue of a great blue heron (Ardea herodias) found dead in Moose Jaw, Saskatchewan, Canada (GenBank accession FJ848337) (4). Primers JH0103 (5’-GGA AAC TCA CCA GGT CCA GA-3’) and JH0105 (5’-AAG CAT CGC GAT TCC ATA AA-3’) amplify an 817 bp region of the genome containing partial 18S rRNA gene, internal transcribed spacer 1, the 5.8S rRNA gene and partial internal transcribed spacer 2. The PCR product of the expected size was obtained from the lung DNA extract. The PCR amplicons were sequenced directly using the amplification primers, and an internal primer, JH0104 (5’-CTT GCG TTG ATT ACG TCC CT-3’). The sequence

Figure 1. Photomicrographs of tissues from the Muscovy duck (Cairina moschata). A — Lung. Air capillaries are expanded with small numbers of lymphocytes, plasma cells, and macrophages. Note clusters of intracytoplasmic yeasts in endothelial cells lining the blood capillaries. Hematoxylin and eosin (H&E). Bar = 100 μm. B — Brain (Choroid plexus). The interstitium is infiltrated with small numbers of lymphocytes and plasma cells, and macrophages. Note cells containing clusters of intracytoplasmic yeasts in the lesion. H&E. Bar = 100 μm. C — Sciatic nerve. Nerve fibers are separated by perivascularly oriented lymphocytes and plasma cells, and macrophages. Note cells containing clusters of intracytoplasmic yeasts in the lesion. H&E. Bar = 100 μm. D — Lung. Note clusters of argyrophilic intracytoplasmic yeasts distributed throughout the lung parenchyma. GMS stain. Bar = 100 μm.
of this amplicon was 96% identical over 804 bp to the rRNA operon sequence identified in the previous great blue heron case (GenBank accession FJ848337). Phylogenetic analysis supported the placement of the organism detected in the duckling lung tissues as a member of the Saccharomycetales Order of yeasts (5). No other sequences were identified with > 83% identity to the query sequence. The partial rRNA operon sequence from the duckling was deposited in GenBank (Accession KM103295).

Discussion

Histopathological lesions with multisystemic intralesional and intracellular yeast organisms, and results of PCR investigation in this case support disseminated yeast infection as the likely cause of acute illness and death of this duckling. The intracellular yeast organisms were similar in tissue distribution and morphology to the intraendothelial organisms described previously in farmed Muscovy and domestic ducks in Canada and the United Kingdom (1–3). In all these cases, mortality occurred between August and December and was typically associated with history of access to a pond. The reported clinical signs in the previous cases range from ailing for a day or so to lameness, weakness, ataxia, respiratory distress, and rapid death. Histological features in the aforementioned cases included interstitial pneumonia, myocarditis, hepatitis, and splenitis with many prominent 1 to 2 μm intraendothelial organisms predominantly in lung tissues similar to the present case, and fewer organisms in other organs. Morphologically similar intraendothelial organisms with the absence of significant inflammatory lesions in multiple organs (predominantly lungs) were reported from a great blue heron (Ardea herodias) that was found dead in Moose Jaw, Saskatchewan, suggesting that wild birds may act as carriers of the yeasts (4). The organisms that were found in the great blue heron were identified as yeast of the Order Saccharomycetales based on ultrastructural morphology and sequence data from the ribosomal RNA operon. The PCR testing and gene sequencing of the RNA obtained from organisms seen in the lung tissues in this case revealed 96% identity to the yeast identified in the previous great blue heron.

Various bacterial and viral infections are reported to cause mortalities in ducklings. Duck viral enteritis (DVE) is a highly contagious disease characterized by acute death with high mortality in Muscovy ducks and infected ducks have hemorrhages and necrosis of internal organs with intraunuclear viral inclusions in multiple body systems (6,7). Muscovy duck parvovirus (MDPV), another viral infection, is reported to cause weakness with pale thigh/leg muscles and myocardium, fibrinous exudate on the liver capsule, asciates, and mortality in Muscovy ducks (8–10). Ducks infected with duck circovirus (DuCV) have histological evidence of necrosis of lymphoreticular tissues and viral inclusions which can lead to immunosuppression and increased susceptibility to secondary infections (11). Duck reovirus (DRV) infection in Muscovy ducks causes necrotizing lesions in the spleen, bursa of Fabricius, liver, and myocardium, and subsequent immunosuppression resulting in secondary infections and eventual mortality (12,13). Duck hepatitis virus (DHV) type I is a fatal virus infection of young ducklings characterized by multisystemic hemorrhages, hepatitis, pancreatitis, and encephalitis (14). The gross and histological lesions seen in this case were not consistent with any of the above viral infections or bacterial septicemia.

The disease in Muscovy ducks caused by yeast appears to be strongly associated with aquatic environments, and occurs following access to ponds that were also visited by other wild birds (1–3). Reports indicated that wild and migratory birds carry various yeasts and contribute to environmental contamination through fecal shedding (15–17). Many aquatic bird species including American white pelicans (Pelecanus erythrorhynchos), lesser scaup (Aythya affinis), and Pekin ducks (Anas platyrhynchos domestica) in Saskatchewan have morphologically similar but unidentified organisms without inflammation in their tissues (G. Wobeser, unpublished data, 1990). In our case, since mallards (Anas platyrhynchos), teals (Anas crecca), Canada geese (Branta canadensis), and muskrats (Ondatra zibethicus) co-mingled with Muscovy ducks on the same pond, the pond environment had a high likelihood of being contaminated by the yeast shed by wild birds.

This report describes disseminated infection and mortality in a Muscovy duckling associated with novel invasive yeast belonging to the Order Saccharomycetales. Yeasts of the Order Saccharomycetales belong to Phylum Ascomycota and comprise about 1000 known Ascomycetes species. These yeasts live as saprobes, often in association with plants, animals, and their interfaces (18). A few of these species account for opportunistic fungal infections in humans and animals (19–23). Wild birds which harbor some of these yeast species as normal inhabitants in their gastrointestinal tract can pose a risk to the health of humans and animals through fecal shedding and environmental contamination (15–17,24–28). Pathogenesis of Muscovy Duck Disease caused by these yeast organisms is unknown. We hypothesize that the duckling in this report was exposed orally or through the respiratory route to the yeast stages in the pond environment which led to disseminated infection and mortality. The underlying factors that led to increased susceptibility of yeast infection in this case are unknown, but poor immunity from immaturity or other undetermined immune suppressors is a possibility. The prevalence, pathogenesis, and impact of this type of yeast infection in wild duck populations are unknown. It appears that this novel yeast species can cause sporadic and local mortality events in Muscovy ducklings, and fungal infections should be considered as a differential diagnosis for acute illness in ducklings with nonspecific gross postmortem findings.

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Case Report Rapport de cas

Vascularized pedicle jejunal graft for closure of large duodenal defect in a dog

Anna Massie, Michael McFadden

Abstract — A Labrador retriever dog was presented for intestinal obstruction resulting in devitalization of portions of the duodenum. A severe perforation, accounting for 70% duodenal circumference, was present at the level of the duodenal papilla. A vascularized jejunal graft was used to close the perforation, representing novel utilization of this grafting technique.

Résumé — Greffe jéjunale d’un pédicule vascularisé pour la fermeture d’un grand défaut duodénal chez un canidé. Un Labrador retriever a été présenté pour un blocage intestinal qui produisait la dévitalisation de portions du duodénum. Une perforation grave, représentant 70 % de la circonférence duodénale, était présente au niveau de la papille duodénale. Une greffe jéjunale vascularisée a été utilisée pour fermer la perforation, ce qui représente une nouvelle utilisation de cette technique de greffe.

Jejunal grafting was used to repair a large defect in the duodenum in which direct closure could not be achieved. This technique provides a novel alternative to more invasive options including gastroenterotomy or gastrojejunotomy with cholecystoenterotomy. This grafting technique is useful in cases of compromised duodenal tissue involving regions in proximity to vital structures including the duodenal papilla and pancreas and may also be applied to cases in which standard closure or resection and anastomosis failed.

Case description

A 4-year-old, 40 kg castrated male Labrador retriever dog was presented with a 1-day history of vomiting. Vomitus periodically contained small pieces of cloth material. The dog had a history of intestinal resection and anastomosis, gastrotomy, and gastropexy approximately 1 year earlier. Further history included steroid administration (trimeprazine with prednisolone) for 1 year due to allergic skin disease, along with a protein-restricted fish and potato diet for food sensitivity.

On physical examination, the dog was quiet, alert, and responsive with appropriate body condition and an estimated 5% to 7% dehydration. Mild ptyalism was noted along with mild discomfort on caudal abdominal palpation. The remainder of the physical examination was within normal limits. A complete blood (cell) count (CBC) was consistent with hemoconcentration (hematocrit 61.9%), and serum chemistry profile revealed hyperglycemia [8.3 mmol/L; reference interval (RI): 3.9 to 7.9 mmol/L], hyperalbuminemia (44 g/L; RI: 22 to 39 g/L), hypokalemia (3.1 mmol/L; RI: 3.5 to 5.8 mmol/L), and elevated alanine aminotransferase (ALT; 122 U/L; RI: 10 to 100 U/L) and alkaline phosphatase (ALP; 1206 U/L; RI: 23 to 212 U/L). Ventrodorsal and right lateral abdominal radiographs were consistent with soft tissue opacity within the gastric lumen and potential plication of small intestine in the caudal abdomen. Abdominal ultrasound revealed fluid distension of the stomach and proximal duodenum. No foreign material was identified, and an intestinal obstruction could not be confirmed.

A nasogastric tube was placed with gastric suctioning every 4 h, along with intravenous fluid therapy with potassium supplementation [20 mEq KCl/L, 120 mL/kg body weight (BW)/d], metoclopramide (Hospira, Lake Forrest, Illinois, USA), 2 mg/kg BW/d, constant rate infusion (CRI), pantoprazole (Wyeth, Philadelphia, Pennsylvania, USA), 1 mg/kg BW, IV, q24h, and maropitant citrate (Zoetis, Kalamazoo, Michigan, USA), 1 mg/kg BW, SQ, q24h. There was a decrease in the volume of suctioned gastric contents obtained and ptyalism improved through the overnight period. The nasogastric tube was removed the following afternoon, and a repeat abdominal ultrasound revealed resolution of gastrointestinal fluid distension. The dog was discharged after 24 h hospitalization with metoclopramide (0.5 mg/kg BW, PO, q8h) after demonstrating willingness to eat in the hospital. Recheck ultrasound examination prior to discharge revealed a stomach mildly distended with gas and a
The dog was re-presented 7 d after discharge for protracted anorexia and vomiting. The owners had noted hyporexia since discharge, and all prehension reportedly induced bilious vomiting. Two bowel movements had been observed since discharge: the first of normal consistency and the second soft but formed. On physical examination, the dog was bright, alert, and responsive. Temperature, heart rate, respiratory rate, and pulse quality were within normal limits. The abdomen was soft and not painful on palpation, with no masses or organomegaly noted. A limited blood panel was performed, revealing electrolytes, ionized calcium, blood glucose, blood urea nitrogen, and creatinine within normal limits. The dog was mildly hemococoncentrated (hematocrit: 51%). An IV catheter was placed and Multiple Electrolytes Injection, Type 2, USP (Plasma-Lyte A; Abbott Animal Health, Abbott Park, Illinois, USA), 12.5 mL/kg BW, IV, was administered as a bolus, followed by a continuous infusion of 120 mL/kg BW per day, IV. Maropitant citrate (Zoetis), 1 mg/kg BW, IV, and famotidine (West-Ward, Eatontown, New Jersey, USA), 1 mg/kg BW, IV, were administered once; nothing was given per os overnight. A limited blood panel was performed, revealing electrolytes, ionized calcium, blood glucose, blood urea nitrogen, and creatinine within normal limits. The dog was mildly hemococoncentrated (hematocrit: 51%). An IV catheter was placed and Multiple Electrolytes Injection, Type 2, USP (Plasma-Lyte A; Abbott Animal Health, Abbott Park, Illinois, USA), 12.5 mL/kg BW, IV, was administered as a bolus, followed by a continuous infusion of 120 mL/kg BW per day, IV. Maropitant citrate (Zoetis), 1 mg/kg BW, IV, and famotidine (West-Ward, Eatontown, New Jersey, USA), 1 mg/kg BW, IV, were administered once; nothing was given per os overnight.

The following morning a CBC revealed a mild normochromic normocytic anemia (RBC 4.5 × 10^6/μL; RI: 4.8 to 9.3 × 10^6/μL), hemoglobin (HGB; 111 g/L; RI: 12.1 to 20.3 g/L), hematocrit (HCT; 32%; RI: 36% to 60%). Serum chemistry profile revealed hypoproteninemia (39 g/L; RI: 50 to 74 g/L) characterized by hypocalcemia (19 g/L; RI: 27 to 44 g/L), elevated ALP (213 U/L; RI: 5 to 131 U/L], hyperglycemia (7.9 mmol/L; RI: 3.9 to 7.7 mmol/L), hypokalemia (2.1 mmol/L; RI: 2.2 to 2.9 mmol/L), hypomagnesemia (0.7; RI: 0.75 to 1.25 mmol/L), and elevated creatine kinase (CK; 944 U/L; RI: 59 to 895 U/L).

Repeat abdominal ultrasound examination revealed a hyper-echoic distal shadowing object measuring 2.5 cm in diameter within the proximal duodenum. Thickened duodenum with hyper-echoic surrounding mesentery was present orad to this region. The remainder of the small bowel and colon were within normal limits, with no peritoneal effusion noted and the remaining organs were unremarkable. Due to the high suspicion of a duodenal foreign body causing complete intestinal obstruction, along with the chronicity of clinical signs, it was elected to pursue an exploratory laparotomy.

A ventral midline abdominal approach was made from xiphoid to pubis. Findings included a moderate amount of peritoneal effusion and foreign material palpable in the stomach, duodenum, and proximal jejunum. The duodenum was plicated, and areas were discolored, suggestive of vascular congestion or impaired blood flow, while some areas were grossly necrotic. A gastrostomy was performed through the ventral stomach wall midway between the lesser and greater curvatures, in order to remove foreign material from the stomach and relieve the anchor site for the remaining linear foreign material. This was closed in 2 layers, with mucosa and submucosa apposed with a simple continuous pattern of 3-0 PDS (Ethicon, Guaynabck, Puerto Rico) and muscularis and serosa closed in an inverting Cushing’s pattern of 3-0 PDS.

Two large perforations were noted in the proximal duodenum. The first was 3 to 5 cm distal to the pylorus, and a second perforation was noted at the caudal duodenal flexure. Once necrotic tissue was debrided from the orad perforation, a 5 cm × 3 cm defect was present involving approximately 70% of the duodenal circumference, with the region of viable tissue involving the mesenteric border (Figure 1). The major duodenal papilla was clearly visible in the area of the defect. The aborad perforation in the caudal duodenal flexure was smaller and measured 2 cm × 3 cm, tissue was debrided.

Initially, primary closure of the orad perforation was attempted using 4-0 PDS in a simple interrupted pattern. This resulted in a narrowed lumen and there was tension on the closure that resulted in sutures tearing through the tissues. A leak-free closure could not be obtained. In order to maintain luminal diameter and decrease tension, a jejunal grafting technique was utilized. A 5-cm segment of healthy jejunum, including jejunal artery and vein, was isolated and mobilized from the middle of the jejunum. The jejunal segment was incised at the anti-mesenteric border to create a rectangular shaped graft which was trimmed as needed (Figure 2), transposed, and sutured in place with 4-0 PDS in a simple interrupted pattern to cover the orad duodenal perforation (Figure 3). Orad-to-aborad orientation was maintained. The graft harvest site was anastomosed using 4-0 PDS in 2 simple continuous appositional patterns. A second routine resection and anastomosis was performed at the aborad duodenal perforation. The abdomen was lavaged with 5 L of sterile saline and a Jackson Pratt drain was placed in the peritoneal cavity prior to closure. The linea alba was closed in a continuous pattern using 0 PDS and the skin was apposed in an intradermal pattern using 2-0 Monocryl (Ethicon) and skin staples.

The dog recovered in the ICU on lactated ringer’s solution (Hospira), 112 mL/kg BW per day, hydromorphine (West-Ward), 0.1 mg/kg BW, IV, q6h, ampicillin/sulbactam (Sagent Pharmaceuticals, Schaumberg, Illinois, USA), 30 mg/kg BW, IV, q8h, enrofloxacin (Bayer, Shawnee Mission, Kansas, USA), 10 mg/kg BW, IV, q24h, pantoprazole (Wyeth), 1 mg/kg BW, IV, q24h, and famotidine (West-Ward), 1 mg/kg BW, IV, q24h. Blood pressure was recorded every 6 h, and packed cell volume
and total protein were recorded every 12 h after surgery. Both parameters remained within normal limits.

Cytology of abdominal effusion obtained from the Jackson-Pratt drain was monitored daily to assess for evidence of septic peritonitis. On the third day after surgery, there was a significant increase in degenerate neutrophils in the abdominal effusion with no intracellular bacteria noted. Peripheral venous blood glucose was 10.5 mmol/L, with a peritoneal fluid glucose of 4.8 mmol/L. Due to the nature of the repair and the changes in abdominal effusion a second exploratory laparotomy was performed.

The incision was opened and the previous surgery site was examined. There was < 100 mL of peritoneal effusion present. A 2 to 3 cm, suspect pancreatic abscess was present near the proximal duodenal repair. The anastomosis sites were intact. The jejunal graft was pink and healthy with no evidence of necrosis. The duodenal repair was isolated with Doyen forceps and saline was injected into the lumen to assess for leakage. Approximately 1 to 2 mm of the graft site repair leaked saline when pressure tested. The defect was reinforced with a single interrupted suture using 4-0 PDS, and the suspect pancreatic abscess was debrided. The peritoneal cavity was lavaged using 6 L of sterile saline and omentum was manually placed in the region of the pancreatic abscess. The Jackson-Pratt drain was replaced and an abdominal culture, revealing abundant *Escherichia coli* and a few *Enterococcus* species, was obtained. Closure was performed in an identical fashion to the previous procedure. The patient recovered in the ICU, receiving medications as previously described.

A CBC and serum chemistry were rechecked 1 day after revision. The CBC revealed a continued normocytic normochromic anemia (RBC 4.3 × 10⁶/μL; HGB 102 g/L; HCT 31%) and leukocytosis (WBC 23 600/μL; RI: 4000 to 15 500/μL). Serum chemistry profile revealed progressive hypoproteinemia (27 g/L) characterized by hypoalbuminemia (13 g/L) and hypoglobulinemia (14 g/L; RI: 16 to .6 g/L), decreased ALT (9 U/L; RI: 12 to 118 U/L), hypocalcemia (1.9 mmol/L), hypomagnesemia (0.7 mmol/L, and elevated amylase (1171 U/L; RI: 290 to 1125 U/L).

The dog was hospitalized with a Jackson-Pratt drain for the following 4 d. The drain was removed based on decreased production and cytologic evaluation of the abdominal fluid. The dog was discharged 5 d following the second surgery. Medications prescribed included amoxicillin/clavulanate potassium (14 mg/kg BW, PO, q12h) and enrofloxacin (6.8 mg/kg BW, PO, q24h).

Upon recheck examination 8 d later, the dog was bright, alert, and responsive with vital signs within normal limits. The incision was intact and appropriate, and skin staples were removed. The owners reported improved appetite with no vomiting, normal water intake, and normal feces. The dog was permitted to return to normal activity and recheck as needed. At the last telephone follow-up, 12 wk following revision surgery, the dog was reported to be doing well with no clinical signs.

**Discussion**

This case represents a successful method of duodenal perforation repair, using a pedicled jejunal graft. This was necessitated by the proximity of the duodenal papilla and inability to perform a standard duodenal closure. To the authors' knowledge, there are
no previous reports of this procedure in the veterinary literature. Previously described surgical procedures for severe proximal duodenal defects include gastroenterotomy, cholecystoenterotomy, serosal patching, and pancreaticoduodenectomy. Because of the potential of long-term complications and potential higher morbidity associated with these procedures, the reported procedure was performed as an alternative.

The jejunum was selected as a suitable candidate for duodenal repair due to a number of intrinsic factors. The jejunum is abundant, allowing a standard resection and anastomosis of the tissue with minimal to no functional effect on the dog. The intestine allows length modification as needed for varying defects (1). The tissue has a low rate of disease and retains resorptive and peristaltic function after resection and grafting (1–3). Additionally, the mesenteric vasculature can be included and provides adequate length to be used in a pedicle fashion (1–3). In the present case, no tension of the vascular pedicle was noted after implantation of the graft. The inherent mobility of the mesentery allowed vascular transposition without visible vascular obstruction or irregular angulation resulting in obstruction of the vasculature.

Perforating ulceration of the duodenum has been reported in humans most commonly with peptic ulcer disease or trauma (4). The small perforations can be repaired with single layer closure and/or omental patching. However, a small subset (1% to 2%) represents giant gastroduodenal ulcerations, defined as greater than 2 to 3 cm in human patients, and presents a challenge for surgical repair (4–6). Repair methods reported include partial gastrectomy, jejunal serosal patch, jejunal pedicled graft, gastrojejunalostomy, and gastric disconnection (4–6). A gastrojejunalostomy reconstruction with gastric patching utilizing the remnant pyloric tissue was reported successfully in 1 case (7), with a second novel method consisting of the use of the ligamentum teres hepatitis to combine laparoscopic and endoscopic modalities in a minimally invasive approach (8). To the authors' knowledge, reports of similar procedures allowing preservation of surrounding structures in dogs are limited.

In humans, jejunal grafting has been used as pedicled, augmented, free segment, or a combination of these (2). The most common procedures reported include pharyngolaryngectomy defect, tracheal, esophageal, and urethral reconstruction, which are currently considered the optimal methods of circumferential pharyngolaryngectomy reconstruction (2,9–12). Reports of jejunal grafting in the veterinary literature are less frequent, though much information in the human literature has been derived from the use of canine models. Two reports examined canine models of tracheal replacement using autologous jejunal free flaps with various intra- and extra-luminal stents, and presented conflicting reports of success (13,14). Aside from thrombosis of the micro vessel anastomosis of the graft and mild secretory effects of the tissue, the remaining morbidity and mortality in these studies are assumed largely associated with the stenting techniques and the specific qualities of the organ being replaced.

The complications reported are believed inapplicable to our case, as microvascular anastomosis was not required, and secretory function of the graft's mucosal layer does not present pathologic complications as with grafting into respiratory tissues. Other reported complications, including stricture formation and vascular thrombosis, were not encountered in this patient, and the second surgery allowed a unique opportunity for visualization of a post-operative graft in situ to definitively exclude these as short-term complications.

Jejunal autografts used for cervical and thoracic esophageal replacement in the dog demonstrated that accepted grafts retained gross and microscopic normalcy, along with peristalsis coordinating with esophageal contractions (15). A second study demonstrated frequency of fistulization and functional stenosis and dismotility in canines with cervical esophageal reconstruction using jejunal grafts (16). These grafts were shown in 1 canine study to maintain baseline motility (3). However, dysphagia is often noted due to incoordination of contractions and sustained local contractions, with the use of metoclopramide demonstrating an improvement in coordinated functional motility (3). Due to the potential demonstrated in these studies, the authors elected to maintain an orad to aborad orientation of the jejunal graft. Treatment with metoclopramide was not pursued in this case due to low suspicion of ileus and no clinical signs deemed secondary to graft dismotility; however, the implication of this decision is unknown.

Further studies are required to determine clinical implications along with the morbidity and mortality associated with the use of jejunal pedicle grafting to repair duodenal defects. Controlled prospective in vivo videofluoroscopic and endoscopic monitoring of graft sites could be considered in order to further demonstrate the functionality associated with the described graft. Though promotility medications were not utilized in this case and no adverse results were noted, further studies may demonstrate the implications of such drugs for coordinated peristalsis and their effects at this location.

This case represents the novel use of a jejunal graft for successful repair of a large circumferential duodenal perforation at the level of the duodenal papilla in a dog. It is unclear if the septic peritonitis that developed after the initial procedure was due to graft leakage or the development of a pancreatic abscess. The leakage seen in the revision surgery was small and may have been due to supra-physiologic pressure applied during leak testing. The results support the use of this technique as a potential method to maintain physiologically relevant structures in this region.

References

Answers to Quiz Corner
Les réponses du test éclair

1. C) Common signs of esophageal obstruction include standing with outstretched neck and gasping. Copious amounts of saliva may be present.

C) Les signes communs d’une obstruction œsophagienne comprennent le fait de se tenir debout avec le cou étiré et une respiration haletante. Une grande quantité de salive peut être présente.


2. D) The auricular artery is exposed, covered by thinner tissue, and easily visualized compared with other arteries.

D) L’artère auriculaire est exposée et recouverte seulement par une peau mince, facilement visible par comparaison aux autres artères énumérées.

3. C) This is a Cheyletiella mite that can infect dogs, cats, rabbits, and humans. The guinea pig is not a reservoir host.

C) Il s’agit de Cheyletiella qui peut infecter le chien, le chat, le lapin et l’humain. Le cobaye n’est pas un hôte habituel.

4. D) Aspiration of a clear fluid indicates a spinal, not epidural placement of the needle. There should be no resistance to a test injection of saline. The “hanging drop” disappearing into the needle is a positive sign of correct placement. No crepitus should be felt after a test injection of air through the epidural needle.


5. C) The adrenal function is normal. In hypoadrenocorticism, a low baseline cortisol concentration with little or no response to ACTH is expected. Clinical signs do not suggest hyperadrenocorticism. An adrenal tumor would give signs consistent with hyperadrenocorticism; the response to ACTH stimulation is typically exaggerated. Clinical signs do not suggest a sex-steroid-secreting adrenal tumor.

Responses of the Canadian colleges of veterinary medicine and the veterinary profession to recommendations of the Truth and Reconciliation Commission: A new way forward

Claire E. Card

The colleges of veterinary medicine (CVM) are engaged in the ongoing discussions about the important and evolving role of veterinarians in society (1). They have broad mandates, are agents of change, and educate many of the leaders of tomorrow. The CVM are uniquely poised to change the national discourse, and transform knowledge, which is relevant to the Government of Canada’s Truth and Reconciliation Commission (TRC) and its “calls to action” concerning post-secondary education (1,2).

In January 2016, the University of Saskatchewan’s University Council, the governing body that oversees all academic affairs of the University, approved a motion that “...emphatically endorses the inclusion of Indigenous (First Nations, Inuit, Métis) knowledge and experiences for the purpose of enabling meaningful and relevant learning outcomes, in all degree programs at the University of Saskatchewan” (3). Thus the question arose “What does the TRC and the associated calls to action have to do with veterinary education and the veterinary profession?” In this article possible responses and actions by the CVM and members of the veterinary profession to honor the calls to action are described as a new way forward.

The TRC was established with a mandate “to learn the truth about what happened in the residential schools and to inform all Canadians about what happened in the schools” (2). The chair of the TRC, the Honourable Justice Sinclair, said “For over 100 years Canada’s Indian, Métis and Inuit children were taken from their families and sent to institutional settings called residential schools, sometimes forcibly, sometimes under threat of incarceration if parental cooperation was not forthcoming, and almost always under the deception that what was being done was in their best interests” (4). There were 130 federally funded church administered residential schools that operated from 1870 to 1996, whose purpose was “to eliminate parental involvement in the intellectual, cultural, and spiritual development of Aboriginal children” in Canada (2). While the word “school” is used to refer to these institutional settings, the education delivered in these institutions was clearly sub-standard, not equivalent to, nor intended to be similar to the education delivered at non-Indigenous schools (2). There were over 150 000 child residents of these schools, and an estimated 80 000 survivors are living today (2). The TRC report chronicled the abuse of indigenous children at residential schools, which included sexual, physical, and emotional abuse and high rates of malnutrition, excessive work, over-crowding, and needless exposure to infectious diseases such as tuberculosis, which lead to unacceptably high child morbidity and mortality (2,5).

Justice Sinclair said “Mainstream Canada sees the dysfunction of Indigenous communities, but have no idea how that happened, what caused it, or how government contributed to that reality through the residential school policy.” The ongoing impacts of abuse experienced at the residential schools include dysfunction from: the loss of indigenous languages and traditional beliefs, loss of parenting skills, unacceptably poor education results, despair that results in runaway rates of suicide, family violence, substance abuse, high rates of incarceration, gang influence, child welfare apprehensions, homelessness, poverty, and family breakdowns (2). In addition, Aboriginal peoples disproportionately experience racism and are marginalized, under-educated, unemployed, and under-paid (5–7). Justice Sinclair said “…just as Indigenous children were taught that they were inferior, so were non-Indigenous children. They do not realize that for the non-Indigenous child, this teaching had an insidious aspect — it reinforced a false belief in their own superiority. This too must be addressed.”

Responses of the CVM and the veterinary profession to reconciliation and the calls to action

The TRC report lists 94 calls to action regarding reconciliation (2) including 8 relevant for veterinary post-secondary education, which may serve as a starting point for the veterinary profession (Table 1). Reconciliation is viewed as a series of actions that leads to different attitudes, new understandings, new ways of relating, and mutual respect (8).

Other calls to action such as numbers 24, 27, and 28 are specific in terms of nursing, medicine, law societies, and law schools, respectively. For example it is recommended that “the Federation of Law Societies ensure that lawyers receive
This will require skills-based training in intercultural competency, conflict resolution, human rights, and anti-racism. There is more flexibility for the veterinary profession to honour the TRC calls to action and reconciliation; however, similar competencies should be expected.

**Educational equity.** The Aboriginal post-secondary educational backlog and employment gap should be eliminated through the provision of sustainable funding. Equity seats for Aboriginal students at all CVM should be created to improve enrolment. Currently 16 of the 17 Canadian medical schools, but only 1 of the 6 CVM, identify a process to make veterinary medical education more accessible for Aboriginal students (9). The WCVM has 2 equity seats per class and 3.5% self-declared Aboriginal students, but an enrolment of 12% is needed to reflect the western Canadian demographic (10). Aboriginal enrolment and graduation targets at CVM should be set and progress published annually. The number of Aboriginal faculty and staff members at universities should be increased through direct action.

**Veterinary pedagogy.** There is an opportunity to reimagine veterinary medical education and create transformative opportunities to repair, encourage, and develop intercultural understanding, empathy, and mutual respect between Aboriginal and non-Aboriginal peoples (2). This should occur through the development of: learning materials about the residential school system and the impacts; fairer representations of Aboriginal peoples, cultures, and histories; the integration of aboriginal subject matter, thought, perspectives, and knowledge across learning environments; teaching anti-racism; and funding for teachers to learn how to effectively integrate indigenous knowledge and teaching methods. There is a need to describe best practices, perform research on reconciliation, and develop respectful and reciprocal relations with Aboriginal communities, agencies, and organizations (2). Decolonizing education has been described as a cornerstone of reconciliation (11) and involves creating a new ethical space in which all good ideas, knowledge, and experiences matter, including those of Aboriginal peoples. This newly constructed ethical space would bring together Aboriginal peoples and non-Aboriginal peoples to develop a common discourse (11).

There is a clear role for veterinary educators to instruct students about the Canadian context of the social determinants of health (SDH), and health inequalities (12). The SDH are factors such as: income and social status; social support networks; education; employment/working conditions; social environments; physical environments; personal health practices and coping skills; healthy child development; gender; and culture (12). Learning about the SDH helps a student understand the structural factors in society that contribute to health, and explains the higher rates of dysfunction and ill-health in the Aboriginal population (2,12). A revised veterinary pedagogy is required that includes the SDH of humans and animals and the barriers to addressing them, along with educational experiences to reinforce the learning.

**Partner in health.** The veterinary profession should strive to be a partner in Aboriginal community health by exposing Aboriginal students to the profession through outreach activities such as classroom visits, clinic tours, attending job fairs, and creating volunteer and employment opportunities. Many Aboriginal communities in inner city core neighborhoods,

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**Table 1. Truth and Reconciliation Commission calls to action that refer to post-secondary education relevant to the veterinary profession**

<table>
<thead>
<tr>
<th>Number</th>
<th>Call to action</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>We call upon the federal government to develop with Aboriginal groups a joint strategy to eliminate educational and employment gaps between Aboriginal and non-Aboriginal Canadians.</td>
</tr>
<tr>
<td>8</td>
<td>We call upon the federal government to eliminate the discrepancy in federal education funding for First Nations children being educated.</td>
</tr>
<tr>
<td>10</td>
<td>We call on the federal government to draft new Aboriginal education legislation with the full participation and informed consent of Aboriginal peoples. The new legislation would include a commitment to sufficient funding and would incorporate the following principles: i. Providing sufficient funding to close identified educational achievement gaps within one generation. ii. Improving education attainment levels and success rates. iii. Developing culturally appropriate curricula. vii. Respecting and honouring Treaty relationships.*</td>
</tr>
<tr>
<td>11</td>
<td>We call upon the federal government to provide adequate funding to end the backlog of First Nations students seeking a post-secondary education.</td>
</tr>
<tr>
<td>23</td>
<td>We call upon all levels of government to: i. Increase the number of Aboriginal professionals working in the health-care field. ii. Ensure the retention of Aboriginal health-care providers in Aboriginal communities. iii. Provide cultural competency training for all health-care professionals.</td>
</tr>
<tr>
<td>62</td>
<td>We call upon the federal, provincial, and territorial governments, in consultation and collaboration with Survivors, Aboriginal peoples, and educators, to: Provide the necessary funding to post-secondary institutions to educate teachers on how to integrate Indigenous knowledge and teaching methods into classrooms.</td>
</tr>
<tr>
<td>63</td>
<td>We call upon the Council of Ministers of Education of Canada to maintain an annual commitment to Aboriginal education issues, including: i. Developing and implementing Kindergarten to Grade Twelve curriculum and learning resources on Aboriginal peoples in Canadian history, and the history and legacy of residential schools. ii. Sharing information and best practices on teaching curriculum related to residential schools and Aboriginal history. iii. Building student capacity for intercultural understanding, empathy, and mutual respect. iv. Identifying teacher-training needs relating to the above.</td>
</tr>
<tr>
<td>65</td>
<td>We call upon the federal government, through the Social Sciences and Humanities Research Council, and in collaboration with Aboriginal peoples, post-secondary institutions and educators, and the National Centre for Truth and Reconciliation and its partner institutions, to establish a national research program with multi-year funding to advance understanding of reconciliation.</td>
</tr>
</tbody>
</table>

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* Principles iv to vi not relevant to this article.
Remote communities, and First Nation’s Reserves in Canada have no available, accessible, and affordable veterinary services (13). There is clearly a need for Canadian veterinarians and veterinary students to partner with communities that lack access to basic services such as: vaccinations, deworming, and spay-neuter surgeries (13). Poor communities that lack access to veterinary services are at risk for canine overpopulation (14) which has lead to aggressive pack behavior with lethal consequences for Aboriginal children (14). First Nation’s Reserves, with only 1.3% of the Canadian population, have a disproportionately high burden (39%) of fatal dog attacks (14). There are no reports in the literature of canine populations reaching sustainable levels without the provision of some veterinary services. Expecting that problems such as canine overpopulation, that are strongly connected to a lack of veterinary services, will disappear on their own, is irresponsible.

**Intercultural learning.** The veterinary community lacks access to Indigenous knowledge and experiences. Reciprocal experiences connected to relevant and meaningful learning outcomes for veterinary students should be arranged with Aboriginal communities. These opportunities may provide a pathway for intercultural learning and at the same time fill an education and service gap (15).

**Advocacy.** Provincial and territorial veterinary associations should be encouraged to work towards solutions to empower and assist underserved communities in the development of sustainable management plans for domestic and farm animals, recognizing the resource constraints. Veterinarians may contribute human, social, or financial capital to narrow the veterinary service gap or find placements for animals.

**Research.** There are many opportunities to participate in research with Aboriginal partners while respecting their right to self-determination, treaty rights, customs, and requirements for confidentiality in the collaboration. Synergies may arise from areas such as research in One Health that links human, animal, and environmental health, and is similar to Aboriginal thought that acknowledges the interconnectedness of humans, animals and the environment (15).

In conclusion, reconciliation is viewed as a series of actions that leads to different attitudes, new understandings, new ways of relating, and mutual respect (8), meaning that the CVM and all members of the veterinary profession have a leadership role to play in honouring the TRC calls to action and finding a new way forward along the path of reconciliation.

**References**


Veterinary Wellness Bien-être vétérinaire

Wellness at work: Building healthy workplaces
Debbie L. Stoewen

Wellness is “the active process of becoming aware of and making choices toward a successful existence, both as individuals within society and within the work environment” (1). Wellness enhances physical, mental, and social well-being, and in one word, “health.” In recent years, wellness has moved into the workplace as enterprises — meaning both for-profit and not-for-profit companies, businesses, firms, institutions and organizations designed to provide goods and/or services — have recognized the role that the workplace can play in supporting worker health. While enterprises have the responsibility to provide safe and hazard-free work environments, they also have the opportunity to promote worker health and foster healthy workplaces (2). The average person spends more time working than any other daily activity of life (3), and, over a lifetime, an average of 90 000 hours on the job (4). The workplace, therefore, is an important setting, not only for health protection — to prevent occupational injury — but also health promotion — to improve overall health and well-being (2,5).

The concept of the healthy workplace is not new, but it has indeed changed, evolving from a nearly exclusive focus on occupational health and safety (managing the physical, chemical, biological, and ergonomic hazards of the workplace) to include work organization, workplace culture, lifestyle, and the community, all of which can profoundly influence worker health (6). Today’s healthy workplace includes both health protection and promotion (6). In short, it includes wellness.

The World Health Organization (WHO) has captured these elements in its definition of the healthy workplace. Based on a systematic literature and expert review, WHO proposes the following definition (5,6):

A healthy workplace is one in which workers and managers collaborate to use a continual improvement process to protect and promote the health, safety and well-being of all workers and the sustainability of the workplace by considering the following, based on identified needs:

- Health and safety concerns in the physical work environment;
- Health, safety and well-being concerns in the psychosocial work environment, including organization of work and workplace culture;
- Personal health resources in the workplace; and
- Ways of participating in the community to improve the health of workers, their families and other members of the community.

Based on this definition, healthy workplace initiatives can be cultivated in four spheres of influence (6, Figure 1).

- Physical work environment
- Psychosocial work environment
- Personal health resources
- Enterprise community involvement

Physical work environment

Many kinds of physical hazards can threaten the health and safety of workers. Examples of such hazards include electrical dangers; ergonomic-related risks (e.g., repetitive motion, awkward posture, or excessive force); radiation exposure, machine-related injuries; and the risk of a work-related motor vehicle crash. These hazards need to be recognized, assessed, minimized, eliminated, or controlled (6,7).

Psychosocial work environment

“Psychosocial hazards” can also threaten the health and safety of workers. These are better known as work stressors and are related to the psychological and social conditions of the workplace, including the organizational culture and the attitudes, values, beliefs and daily practices, as opposed to the physical conditions of the workplace (6). They can be harmful to the mental and physical health of workers, with evidence of 2 to 3 times greater risk of mental illness, injuries, back pain, and workplace conflict and violence (6).

As derived directly from the WHO Healthy Workplace Framework and Model (6):

Examples of psychosocial hazards include but are not limited to:

- Poor work organization (problems with work demands, time pressure, decision latitude, reward and recognition, support from supervisors, job clarity, job design, poor communication)
- Organizational culture (lack of policies and practice related to dignity or respect for all workers, harassment and bullying, gender discrimination, intolerance for...
• Ethnic or religious diversity, lack of support for healthy lifestyles
• Command and control management style (lack of consultation, negotiation, two-way communication, constructive feedback, and respectful performance management)
• Lack of support for work/life balance

Examples of ways to influence the psychosocial work environment:
• Eliminate or modify at the source:
  – Reallocation to reduce workload, remove supervisors or retrain them in communication and leadership skills, enforce zero tolerance for workplace harassment and discrimination
• Lessen impact on workers:
  – Allow flexibility to deal with work/life conflict situations; provide supervisory and co-worker support (resources and emotional support); allow flexibility in the location and timing of work; and provide timely, open, and honest communication
• Protect workers by raising awareness and providing training to workers, for example regarding conflict prevention or harassment situations

**Personal health resources**

The provision of personal health resources in the workplace can support or motivate worker efforts to improve or maintain their personal health practices or lifestyle, as well as monitor and support their physical and mental health (6,7). Such resources include health services, information, opportunities, and flexibility. Although work can get in the way of making healthy lifestyle choices, motivated and innovative employers do what they can to remove the barriers and support the personal health goals of their employees.

As derived directly from the *WHO Healthy Workplace Framework and Model* (6):

Examples of personal health resource issues in the workplace:
Employment conditions or lack of knowledge may make it difficult for workers to adopt healthy lifestyles or remain healthy. For example:
• Physical inactivity may result from long work hours, cost of fitness facilities or equipment, and lack of flexibility in when and how long breaks can be taken
• Poor diet may result from lack of access to healthy snacks or meals at work, lack of time to take breaks for meals, lack of refrigeration to store healthy foods, or lack of knowledge

Examples of ways to enhance workplace personal health resources:
These may include medical services, information, training, financial support, facilities, policy support, flexibility, and promotional programs to enable and encourage workers to develop healthy lifestyle practices. Some examples are:
• Provide fitness facilities for workers or a financial subsidy for fitness classes or equipment
• Encourage walking and cycling in the course of work functions by adapting workload and processes
• Provide and subsidize healthy food choices in cafeterias and vending machines
• Allow flexibility in timing and length of work breaks to allow for exercise

**Enterprise involvement in the community**

Community involvement refers to the ways in which a workplace goes above and beyond to involve itself within the community in which it operates, offering expertise and resources (beyond its day-to-day offerings) to support the social and physical wellbeing of the community (6). Activities that positively influence the physical and mental health, safety, and well-being of workers and their families offer the greatest advantage. Examples include spearheading a community project and volunteering in community initiatives to benefit those in need.

Ultimately, as stated in the *WHO Healthy Workplace Framework and Model* (Burton, 2010):

A healthy workplace aims to:
• Create a healthy, supportive, and safe work environment
• Ensure that health protection and health promotion become an integral part of management practices
• Foster work styles and lifestyles conducive to health
• Ensure total organizational participation
• Extend positive impacts to the local and surrounding community and environment

Those in veterinary medicine might ask, “But how does all of this apply to me in the veterinary workplace? Why would I want to...
think beyond the necessities of occupational health and safety when there's already more than enough to think about — and do — with running a practice.” These are valid questions, and the answers are just as important as the questions.

First, it is the right thing to do. Ensuring employee health and safety follows one of the most basic of universally accepted ethical principles, “do no harm” (6). There is a moral imperative to create healthy veterinary workplaces that do not harm the mental or physical health, safety, or well-being of its employees (6).

Second, it is the smart thing to do. Worker health, safety and well-being not only benefit workers and their families but also have substantial implications for the productivity, competitiveness and sustainability of enterprises (5). There is a wealth of data demonstrating that in the long term, businesses that protect and promote employee health tend to be the most successful (6). They have the most physically and mentally healthy and satisfied employees; less sick leave, disability, and turnover; and higher productivity and quality of products and services (6, 7). As recognized by the WHO, “The wealth of business depends on the health of workers” (6). Accordingly, to support workers is to support the enterprise. The two are inextricably entwined. Businesses that do not protect and promote employee health incur significant costs on multiple levels.

And third, it is the legal thing to do (sort of!). A safe and healthy work environment is considered a fundamental human right (8). The legislation varies tremendously across geographies, but at minimum, there is always legislation requiring employers to protect workers from hazards in the workplace that could cause injury or illness. Accreditation Canada, an independent, not-for-profit organization that accredits health care and social services organizations across Canada, addresses the need for health care organizations to create a culture that supports a safe and healthy work environment (9). A safe and healthy work environment is classified as “a strategic and high priority.” The situation is the same in the United States. The Joint Commission on Accreditation of Healthcare Organizations, an independent, not-for-profit organization that accredits and certifies nearly 21,000 health care organizations that support a safe and hazard-free workplaces, we have the opportunity to promote health and well-being and foster healthy workplaces. We can encompass the opportunities if we expand our circles of responsibility. In so doing, we meet the moral imperative to create workplaces that do not harm the mental or physical health, safety, or well-being of our employees; we gainfully increase the productivity, competitiveness, and sustainability of our practices; and we take the lead in our profession.

References
Veterinary Practice Management
Gestion d’une clinique vétérinaire

The benefits of pre-booking
Les avantages des rendez-vous à l'avance

Darren Osborne and Chris Doherty

Veterinarians are beginning to discover what dentists have known for a long time: pre-booking works. Scheduling a client for their next appointment before they leave the building during their current appointment is proving to be a success. Hospitals that have implemented this strategy are not only posting impressive metrics, they are reporting that it is more efficient and less expensive than the conventional ways of getting clients to book appointments, such as postcards or reminder phone calls.

After a disappointing 2015 across much of Canada, the need for strategies to reverse the decline is clear. Gross revenue dropped, while expenses ticked slightly upward, resulting in a fall of net income (Figure 1). Much of the decline in revenue can be explained by the concurrent reduction in the number of current clients (Table 1). Fee increases have helped maintain revenues in the face of fewer clients, but cannot make up the entire shortfall. At a certain point, clients need to be re-attracted and retained to ensure a successful practice.

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Three things have to take place before a client comes in for their appointment: i) the veterinary hospital has to make contact with the client; ii) an appointment time has to be determined; and iii) the client has to actually show up for the scheduled appointment.

Making contact

The conventional method of accomplishing this is usually by sending generic postcards, asking clients to call the hospital and book an appointment. However, this can be both costly and inefficient. The costs involved in printing and mailing postcards to all the hospital's clients can quickly become staggering. Additionally, it is not a very efficient way of getting clients to book appointments, as it is passive, requires the client to call the hospital (during business hours), and may be disregarded or thrown out with the junk mail.

While phone call reminders are certainly a better option, allowing for an active conversation and for the appointment to be booked at the time of contact, this method can be time-consuming. Staff members commonly need to make multiple phone calls to a client in order to actually speak with them; leaving a reminder voicemail results in many of the same issues encountered when sending a postcard.

Pre-booking simplifies much of this process. With the client standing right in front of them after paying the bill for their current visit, hospital staff have already achieved the first step of making contact. This requires far less time and effort than making contact through postcards, phone calls, or e-mails.

Establishing an appointment

Establishing an appointment time is typically where hospitals begin to drop the ball on pre-booking. However, it can be quite easy, even if the appointment is a year away, when done properly. Dental office staff have mastered this, as anyone who has tried
to leave their dentist without being pre-booked can attest to. The key, as in many aspect of veterinary medicine, is effective communication.

Rather than asking clients if they would like to be pre-booked (which, given human nature, they will likely say no), the next appointment should simply be scheduled. Tell the client, “We want to make sure Fido gets in on time for the healthcare he needs, so I’ve booked you for an appointment next year at the same time on the same day. This way, we can ensure that even as we get into our busy season, the doctor will have time to see you and Fido.”

There may be pushback from some clients, who will offer to call the hospital later to book a time, or state that they don’t know their schedule yet. This is easily addressed by telling clients, “That is totally understandable. If anything comes up and you need to reschedule Fido’s appointment, you can call us at any time to make that change. We’ll also give you a call before the appointment, so you can reschedule at that time as well.” Rather than treating pre-booking as an imposition on clients, shift the perception so that it is seen as enhancing the convenience of the veterinary experience.

**Showing up**

Once the first two steps are completed, the final task is to get the client to actually show up for their appointment. Reminder phone calls, made approximately a week in advance of the scheduled appointment, are the most commonly employed method. Some practices, however, are turning to technology to facilitate this process. Reminder e-mails and text messages allow clients to confirm their appointment time with the click of a button.

Another method that is gaining popularity is to have clients put the pre-booked appointment into their calendar (through use of their smartphone) at the time of pre-booking. That way, one year later, not only is the veterinary hospital going to be

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**Prendre un rendez-vous**

C’est habituellement lors de la prise de rendez-vous que les cliniques commencent à commettre des erreurs. C’est une tâche aisée, même si le rendez-vous n’a aura lieu que dans un an, lorsqu’elle est réalisée de manière appropriée. Signalons que le personnel des cabinets de dentistes a maîtrisé cet art et ce fait sera confirmé par toute personne qui a déjà tenté de quitter le cabinet du dentiste sans prendre son prochain rendez-vous. L’essentiel, tout comme bien d’autres aspects de la médecine vétérinaire, est une communication efficace.

Plutôt que de demander aux clients s’ils aimerait prendre leur prochain rendez-vous et, compte tenu de la nature humaine, ils répondront probablement non), le prochain rendez-vous devrait seulement être fixé. Dites au client : «Nous désirons vous assurer que Fido recevra les soins dont il a besoin au bon moment, alors nous vous avons fixé un rendez-vous au même moment l’an prochain. De cette manière, nous pouvons garantir que, même si la clinique connaît une période achalandée, le médecin aura le temps d’examiner Fido.»

Des clients pourront manifester une certaine réticence et ils offriront d’appeler la clinique plus tard pour prendre rendez-vous s’ils diront qu’ils ne connaissent pas encore leur horaire. On peut facilement régler cette situation en disant aux clients : «Nous comprenons parfaitement. S’il survient un imprévu et que vous devez changer le rendez-vous de Fido, vous pouvez nous appeler en tout temps. Nous vous appellerons aussi avant le rendez-vous et vous pourrez le changer à ce moment si vous le désirez.» Plutôt que d’envisager la prise de rendez-vous à l’avance comme un dérangement pour le client, il faut l’envisager comme une façon de lui faciliter la vie et d’améliorer l’expérience vétérinaire.

**Se présenter au rendez-vous**

Une fois que les deux premières étapes ont été réalisées, la dernière tâche consiste à veiller à ce que le client se présente à son rendez-vous. Des rappels téléphoniques, effectués environ une semaine à l’avance du rendez-vous, sont la méthode la plus fréquemment employée. Cependant, certaines pratiques se tournent vers la technologie pour faciliter ce processus. Des courriels de rappel et des messages texte permettent aux clients de confirmer le rendez-vous en un seul clic.

Une autre méthode qui gagne en popularité consiste à demander aux clients d’inscrire leur rendez-vous dans leur

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**Table/Tableau 1.** Average number of current clients per FTE DVM by province and national weighted average from 2012 to 2015 for companion animal hospitals

<table>
<thead>
<tr>
<th>Province</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
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<td>NA/n.d.</td>
<td>1389</td>
<td>1778</td>
</tr>
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</table>

NA --- Not available. /n.d. --- non disponible.
reminding them of their upcoming appointment, their own schedule will notify them as well.

**The metrics of pre-booking**

The Ontario version of the 2016 Practice Owners Economic Survey included a question on whether or not the hospital was currently pre-booking clients for their next routine appointment. This allows for a comparison to be made between those hospitals that are currently pre-booking, and those that are not. The number of clients, as well as revenue, in those veterinary hospitals that employ pre-booking are posting stronger figures than those that are not (Table 2).

The median number of active clients per FTE is 747 for hospitals that are pre-booking. In contrast, the median is 724 for hospitals that are not pre-booking, a difference of 3.2%.

The median revenue per DVM hour is $289.10 (or $505 925 per FTE) for hospitals that are pre-booking; it is $270.33 (or $473 078 per FTE) for hospitals that are not. This is a 6.9% difference.

While correlation does not equal causation, it is clear that those hospitals taking advantage of pre-booking are excelling during difficult economic times. Finally, perhaps the most compelling evidence in favor of pre-booking is that if it didn’t work, the dentists would have abandoned it years ago. It’s time for veterinarians to follow suit.

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Les données des rendez-vous à l’avance

La version de l’Ontario du Sondage économique 2016 auprès des propriétaires de pratique incluait une question demandant si la clinique prenait des rendez-vous à l’avance pour le prochain rendez-vous régulier. Les réponses à cette question permettent d’effectuer une comparaison entre les cliniques qui prennent les rendez-vous à l’avance et celles qui ne le font pas. Les cliniques vétérinaires qui ont recours aux rendez-vous à l’avance affichent des chiffres supérieurs pour le nombre de clients ainsi que pour les recettes à ceux des cliniques qui ne prennent pas de rendez-vous à l’avance (Tableau 2).

Le nombre médian de clients actifs par ETP est de 747 pour les cliniques qui prennent des rendez-vous à l’avance. Par contraste, la médiane est de 724 pour les cliniques qui ne prennent pas de rendez-vous à l’avance, soit une différence de 3,2 %.

Les recettes médianes par heure de travail d’un vétérinaire s’établissent à 289,10 $ (ou 505 925 $ par ETP) pour les cliniques qui prennent des rendez-vous à l’avance, et elles sont de 270,33 $ (ou de 473 078 $ par ETP) pour les cliniques qui ne fixent pas de rendez-vous à l’avance. Il s’agit d’une différence de 6,9 %.

Même si cette corrélation n’équivaut pas nécessairement à un lien de cause à effet, il est clair que les cliniques qui ont recours aux rendez-vous à l’avance obtiennent d’excellents résultats durant des périodes économiques difficiles. Enfin, la preuve la plus convaincante en faveur de la prise de rendez-vous à l’avance est que si cette méthode ne fonctionnait pas, les dentistes l’auraient abandonné depuis longtemps. Il est maintenant temps pour les vétérinaires d’emboiter le pas.
History and clinical signs

A 3-year-old spayed female golden retriever dog was examined at the ophthalmology service at the Western College of Veterinary Medicine for evaluation of a cloudy, painful left eye. The dog was presented to her referring veterinarian one week previously and therapy was initiated with topical diclofenac sodium 0.1% (Voltaren ophtha; Novartis, Mississauga, Ontario), q6h, in addition to fucidic acid 1% (Fucithalmic Vet; Aventix Animal Health, Flamborough, Ontario), q12h. The menace response was absent in the left eye. Direct and consensual pupillary light reflexes were absent in the left eye as was the left to right consensual pupillary light reflex. Palpebral and occulocephalic reflexes were present bilaterally. Schirmer tear test (Schirmer Tear Test Strips; Alcon Canada, Mississauga, Ontario) values were 5 and 11 mm/min in the right and left eyes, respectively. The intraocular pressures were estimated with a rebound tonometer (Tonvet; Tiolat, Helsinki, Finland) and were 9 and 52 mmHg in the right and left eyes, respectively. Fluorescein staining (Fluorets; Bausch & Lomb Canada, Markham, Ontario) was negative bilaterally. On direct examination the left eye had medial strabismus associated with a large, mass-like thickening at the dorsolateral aspect of the globe. Marked conjunctival hyperemia, episcleral congestion, corneal edema, and peripheral corneal vascularization were also present. Following application of 0.5% tropicamide (Mydriacyl; Alcon Canada, Mississauga, Ontario) biomicroscopic examination (Osram 64222; Carl Zeiss Canada, Don Mills, Ontario) revealed an opacity posterior to the lens in the left eye. Indirect ophthalmoscopic (Heine Omega 200; Heine Instruments Canada, Kitchener, Ontario) examination was not possible in the left eye due to corneal opacity and medial strabismus. The right eye had a single focal area of tapetal hyporeflectivity. An ocular ultrasound was completed which confirmed a complete retinal detachment with hyperechoic subretinal opacities in the left eye in addition to a hyperechoic mass in the region of the dorsolateral ciliary body. A photograph of the left eye at presentation is provided for your assessment (Figure 1a).

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

Discussion

The clinical diagnoses were an intraocular mass with presumed extraocular extension, panophthalmitis, retinal detachment, and secondary glaucoma of the left eye, in addition to bilateral keratoconjunctivitis sicca. The focal retinal lesion in the right eye was considered of unknown significance at that time.

The differential diagnoses for a mass lesion of the eye include neoplasia or inflammation, particularly a granulomatous inflammatory process. Retinal detachment of this type may occur with subretinal accumulation of fluid and/or cellular material which may be inflammatory or neoplastic in origin. Secondary glaucoma is a common sequela to severe intraocular inflammation as well as intraocular neoplasia. Keratoconjunctivitis sicca
The dog returned 5 days later due to rapid enlargement of the right eye. Indirect ophthalmoscopy revealed a large, subretinal mass involving the posterior pole and extending into the vitreous. Magnetic resonance imaging (MRI) of the orbit and brain confirmed the presence of a large, enhancing mass involving the posterior pole and adjacent retina. The dog was referred for further evaluation and treatment.

The referring veterinarian initiated systemic antifungal therapy with itraconazole (7 mg/kg PO q24h) for at least 4 to 6 months (11). During this time, the dog's condition improved gradually, but the mass persisted. In the absence of clinical signs of progression, the therapy was tapered and discontinued after 12 months, with no recurrence noted.

In conclusion, Blastomycosis is a systemic fungal infection that can affect multiple organ systems, including the eye. Early recognition and prompt initiation of appropriate antifungal therapy are crucial for successful management. Close monitoring and follow-up are essential to assess the response to therapy and detect any potential recurrence.

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