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Cancer cells are rapidly dividing out-of-control cells that mutate frequently and modulate immune regulators in order to hide from the immune system. However, immunotherapy is being developed to unleash the power of the immune system to locate and destroy cancer cells. Advances in this field have resulted in remarkable successes (1,2). Immunotherapy technologies include i) monoclonal antibodies, ii) inhibition of T-cell checkpoint molecules, which are regulators that limit the attack of T-cells on host cells, iii) immune modulators, and iv) vaccines that target the immune system.

i) Monoclonal antibodies are produced in the laboratory and are designed to identify antigens linked to cancer cells. These antibodies fight cancer in a variety of ways (2). Some naked antibodies attach to cancer cells, marking them for destruction by the immune system. Others bind to cancer cell antigens that are needed for growth or spread of the cells. Still others bind to checkpoint inhibitors (discussed later). Antibodies may also be combined with other substances such as radioactive particles or a chemotherapy drug allowing these toxic agents to be concentrated at the site of cancer cells. Bi-specific monoclonal antibodies are another class of immuno-therapeutic agent; they are produced against both a cancer cell antigen and an antigen on a T-cell. These antibodies bring the cancer cell and the T-cell together, allowing the T-cell to kill the cancer cell. Yet another type of monoclonal antibody therapy involves a chimeric antigen receptor based on a specific cancer antigen (1,2). The patient’s T-cells are harvested and subjected to ex vivo engineering, which adds a receptor for the cancer cells before they are returned to the patient. The modified T-cells are able to bind to cancer cells and destroy them.

ii) Inhibition of a checkpoint inhibitor is now the basis of several immunotherapy drugs in clinical use in humans (2). Checkpoint inhibitors are molecules that put the brakes on the immune system, preventing it from attacking normal

Les cellules cancéreuses divisent rapidement les cellules hors de contrôle en mutation fréquente qui modulent les régulateurs immunitaires afin de se cacher du système immunitaire. Toutefois, une immunothérapie est en voie d’être développée afin de libérer le pouvoir du système immunitaire et de repérer et détruire les cellules cancéreuses. Les progrès dans ce domaine ont produit des succès remarquables (1,2). Les technologies de l’immunothérapie incluent i) les anticorps monoclonaux, ii) l’inhibition des molécules du point de contrôle des cellules T, qui sont des régulateurs qui limitent l’attaque des cellules T sur les cellules hôtes, iii) les modulateurs immunitaires et iv) les vaccins qui ciblent le système immunitaire.

i) Les anticorps monoclonaux sont produits en laboratoire et ils sont conçus afin d’identifier les antigènes associés aux cellules cancéreuses. Ces anticorps luttent contre le cancer de diverses façons (2). Certains anticorps nus s’attacher aux cellules cancéreuses en les marquant aux fins de destruction par le système immunitaire. D’autres se lient aux antigènes des cellules cancéreuses qui sont nécessaires pour la croissance ou la propagation des cellules. D’autres encore se lient aux inhibiteurs de point de contrôle (qui sont discutés plus loin). Les anticorps peuvent aussi être combinés à d’autres substances, comme des particules radioactives ou des médicaments de chimiothérapie, qui permettent à ces agents toxiques de se concentrer sur le site des cellules cancéreuses. Les anticorps monoclonaux bispécifiques sont une autre classe d’agents immunothérapeutiques et ils sont produits à la fois contre un antigène de cellule cancéreuse et un antigène sur une cellule T. Ces anticorps réunissent la cellule cancéreuse et la cellule T, permettant à la cellule T de tuer la cellule cancéreuse. Un autre type de thérapie des anticorps monoclonaux comporte un récepteur d’antigène chimérique basé sur un antigène spécifique du cancer (1,2). Les cellules T du patient sont récoltées et soumises à une ingénierie ex vivo qui ajoute un récepteur pour les cellules cancéreuses avant de les
cells. Some cancers are able to camouflage themselves with these molecules, thereby shutting down the immune response against them. Monoclonal antibodies against these checkpoint inhibitors allow the immune system to recognize and attack the cancer cells. This approach is now used against several cancers including melanoma, non-small cell lung cancer, renal carcinoma, and Hodgkin lymphoma. It has been effective against advanced tumors and has had enhanced activity in combination with chemotherapeutic drugs. The checkpoint inhibitor drugs are expensive: one of them presently has sales of almost $4 billion in the United States and is expected to achieve sales of over $11 billion in 5 years. The potential for substantial rewards is driving research in this field. Much research is still needed to determine why this approach works for some patients and not others and to moderate serious adverse effects that can occur.

iii) *Immune modulators* that nonspecifically boost the immune system are also used against cancers. These include immune system components such as interleukins and interferons as well as immunomodulating drugs that enhance the immune response (2). One such drug is BCG (Bacille Calmette-Guerin), which is very effective against superficial bladder cancer and noninvasive transitional cell carcinoma in humans.

iv) *Vaccines* that target cancer cells are also being used to treat or prevent certain cancers (2). Prostate cancer cells can be attacked by the patient’s immune system cells that have been converted to dendritic cells and exposed to a prostate cell antigen in the laboratory. These cells are returned to the patient and are able to attack the cancer cells. Vaccines that target cancer causing viruses such as the human papilloma virus, are also used to prevent some cancers.

Progress is also being made in immunotherapy in veterinary medicine (1). Sarcoïds in horses and ocular squamous cell carcinoma in cattle have for decades been shown to be treated effectively with injection of BCG into the lesions. Tumor vaccines have had some success but only a limited number of canine tumor antigens have been identified, limiting the use of these vaccines in dogs. However, a melanoma vaccine, based on injection of plasmid DNA that encodes the human tyrosinase gene (tyrosinase is expressed on the surface of melanoma cells), is licensed for use in dogs. There are conflicting reports on its effectiveness. Recent studies have reported on an autologous cancer vaccine that can be used against all types of resectable cancer (3) and a chimeric antigen approach involving transfer of modified T-cells to fight osteosarcoma in dogs (4).

Immunotherapy holds considerable promise for animals as well as humans. Animals will benefit from the use of animal models of human cancer as well as the work of researchers in veterinary oncology.

**References**


*ÉDITORIAL*

iii) L’*immunothérapie* qui renforce le système immunitaire de manière non spécifique sont aussi utilisés contre les cancers. Ils incluent des composants du système immunitaire comme les interleukines et les interférons ainsi que des médicaments immunomodulateurs qui amplifient la réponse immunitaire (2). Un tel médicament est le BCG (Bacille Calmette-Guérin), qui est très efficace contre le cancer superficiel de la vessie et le carcinome transitionnel non invasif chez les humains.

iv) Les *vaccins* qui ciblent les cellules cancéreuses sont aussi utilisés pour traiter et prévenir certains cancers (2). Les cellules du cancer de la prostate peuvent être attaquées par les cellules du système immunitaire du patient qui ont été converties en des cellules dendritiques et exposées à l’antigène de la cellule de la prostate en laboratoire. Ces cellules sont ensuite retournées au patient et peuvent s’attaquer aux cellules cancéreuses. Les vaccins qui ciblent des cancers causant des virus, comme le virus du papillome humain, sont aussi utilisés pour prévenir certains cancers.

De plus, des progrès sont en voie d’être réalisés en immunothérapie dans le domaine de la médecine vétérinaire (1). Depuis des décennies, on observe le traitement efficace des sarcoïdes chez les chevaux et du carcinoma oculaire des bovins par l’injection de la BCG dans les lésions. Des vaccins pour les tumeurs ont aussi connu un certain succès mais seulement un nombre limité d’antigènes des tumeurs canines ont été identifiés, ce qui limite l’usage de ces vaccins chez les chiens. Cependant, un vaccin contre le mélanome, basé sur l’injection de l’ADN plasmidique qui encode le gène humain de la tyrosinase (la tyrosinase est exprimée à la surface des cellules du mélanome), est homologué pour utilisation chez les chiens. Des rapports conflictuels ont été publiés sur son efficacité. Par ailleurs, des
études récentes ont fait état d’un vaccin autologue contre le cancer qui peut être utilisé contre tous les types de cancer réséquables (3) et d’une approche aux antigènes chimériques comportant le transfert de cellules T modifiées pour combattre l’ostéosarcome chez les chiens (4).

L’immunothérapie s’avère très prometteuse pour les animaux ainsi que pour les humains. Les animaux profiteront de l’utilisation de modèles animaux des cancers humains ainsi que du travail des chercheurs en oncologie vétérinaire.

Bibliographie


Carlton Gyles

Les opinions exprimées dans cette rubrique sont celles du rédacteur en chef.
COMPANION ANIMAL

• Cannabis and Companion Animals
  Breakfast Presentation
  – Dr. Katherine Kramer, Vancouver Pet Hospital, Vancouver, BC

• How I Manage Endocrine Diagnostic and Therapeutic Problems
  – Dr. Ellen Behrend, College of Veterinary Medicine, Auburn University, Auburn, AL, USA

• Critical Care
  – Dr. Scott Shaw, VCA, Oxford, MA, USA

• Small Animal Dermatology
  – Dr. John Angus, Animal Dermatology Clinic, Pasadena, CA, USA

• Cardiology
  – Dr. Sonya Gordon, Department of Small Animal Clinic Science, College of Veterinary Medicine & Biomedical Science, Texas A & M University, TX, USA

EQUINE

• Antimicrobial/Infection Therapy
  – Dr. Steeve Giguere, Professor and Hodgson Research Chair in Equine Studies, Veterinary Medical Center, University of Georgia, GA, USA

• Equine Emergencies
  – Dr. Thomas Divers, Cornell University, Ithaca, NY, USA

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  – Dr. Derek Knottenbelt, Equine Medical Solutions, Stirling Scotland, UK

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• Repro Synch
  – Dr. Roy Lewis

• Repro Nutrition, Repro Infections
  – Dr. Cheryl Waldner, Western College of Veterinary Medicine, Saskatoon, SK

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  – Dr. Shea Cox, Certified Hospice Veterinarian and Pain Practitioner, Bridge Veterinary Services, Berkeley, CA, USA

• Delivering effective recommendations, overcoming exam room barriers, communicating cost to achieve optimal outcomes
  – Dr. Jason Coe, Associate Professor, Dept. of Population Medicine, Ontario Veterinary College, Guelph, ON, CAN

• Vets Gone Viral: An interactive workshop to make you stand out online
  – Ms. Danielle Lambert, Snout Consulting, Portland, OR, USA

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• What to do in the first five minutes, Nursing stat: critical care, GASP: respiratory emergencies, Red, white and blue: transfusion medicine in dogs and cats
  – David Liss, RVT, Program Director, Vet Tech Program, Platt College and ICU Tech at VCA Vet Specialists, CA, USA

• Large Animal Medicine for Techs:
  – Sperm Morphology
    – Dr. Colin Palmer

  – Treatment and Control of Milk Fever
    – Dr. Chris Luby

  – Ultrasound for Technologists
    – Dr. Dinesh Dadarwal

  All speakers from the Western College of Veterinary Medicine, Saskatoon, SK

OTHER CE EVENTS:

ABVMA/UCVM Wet Labs – Fri. Oct. 12, 2018

ABVTA Pre-Conference CE – Sat. Oct. 13, 2018

The ABC’s of ECG’s, Blocked Cats and GDVs – David Liss, RVT - Program Director, Vet Tech Program, Platt College and ICU Tech at VCA Vet Specialists, CA, USA

Keynote Lunch Presentation – Tues. Oct. 16, 2018
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Ethical question of the month — August 2018

Emergency on-farm slaughter is meant to provide a practical solution to situations in which an animal cannot be humanely transported to a slaughter facility but is fit for human consumption. Emergency slaughter involves killing and bleeding the animal on-farm before transporting the carcass to a meat plant for processing. This practice allows the farmer to recover some of the animal’s value and removes the incentive to “hang on” to a compromised animal hoping it improves so it can be transported alive to a slaughter facility. Emergency slaughter provisions, therefore, can reduce the risk of unnecessary suffering in livestock. For example, if a feedlot steer seriously injures a limb on a weekday morning, under ideal conditions, the steer can be isolated and slaughtered on-farm within hours of the incident. However the possibility of recovering some value from an injured animal means that the same injury on a Friday evening may cause the animal to be held over the weekend without treatment until an abattoir is available to handle the carcass. In such cases the emergency slaughter option could be seen as contributing to animal suffering. How should one balance the benefits of emergency slaughter with the increase in suffering it may create in other situations?

Question de déontologie du mois — Août 2018

Un abattage d’urgence à la ferme sert de solution pratique dans les situations où un animal ne peut pas être transporté sans cruauté vers un abattoir mais est toujours propre à la consommation humaine. L’abattage d’urgence consiste à tuer et à saigner l’animal à la ferme avant le transport de la carcasse à l’établissement de traitement des viandes. Cette pratique permet à l’agriculteur de récupérer une partie de la valeur de l’animal et supprime l’incitatif de conserver un animal fragilisé dans l’espoir que son état s’améliore afin qu’il puisse être transporté vivant à un abattoir. Par conséquent, le protocole d’abattage d’urgence peut réduire le risque de souffrances inutiles chez le bétail. Par exemple, si un bouvillon du parc d’engraissement se blesse gravement à un membre un jour de semaine, dans des conditions idéales, le bouvillon pourra être isolé et abattu à la ferme quelques heures après l’incident. Cependant, la possibilité de récupérer une partie de la valeur d’un animal blessé signifie que, si la même blessure se produit un vendredi soir, il faudra peut-être garder l’animal sans traitement pendant la fin de semaine jusqu’à ce qu’un abattoir soit disponible pour traiter la carcasse. Dans de tels cas, l’option d’abattage d’urgence pourrait être considérée comme un élément contribuant aux souffrances de l’animal. Comment devrait-on équilibrer les avantages de l’abattage d’urgence avec les souffrances accrues qu’il peut occasionner dans d’autres situations?

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, T onowl ine, Beltwood, 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.
Ethical question of the month — May 2018

A 6-month-old crossbred dog is presented to you early one morning with unusual central nervous system signs. The husband and wife are new clients and appear "edgy." They are there with their two young children. It is difficult for you to obtain a clear history regarding the onset or progression of the clinical signs. Due to the reluctance of the couple to provide an adequate history, you assure them that anything they tell you will be kept confidential within the veterinary-client-patient relationship. They then admit that the dog consumed some of their recreational opioids. The dog responds well to treatment with naloxone. The couple and their children are relieved and grateful. You are not comfortable lecturing these people about the dangers of recreational narcotics; however, with two young children and the dog as evidence that these drugs are not always stored in a secure manner, it does not seem right to register this as a successful treatment outcome and get on with your day. You have a professional obligation to report animal abuse. **What are your professional obligations in this situation?**

Question de déontologie du mois — Mai 2018

Un matin, un chien de race croisée âgé de six mois manifestant des symptômes inhabituels du système nerveux central vous est présenté. L’homme et la femme sont de nouveaux clients et ils semblent agités. Ils sont là avec leurs deux jeunes enfants. Il vous est difficile d’obtenir une anamnèse claire concernant l’apparition ou la progression des signes cliniques. En raison de la réticence du couple à fournir une anamnèse adéquate, vous les rassurez que leurs propos demeureront confidentiels dans le contexte de la relation vétérinaire-client-patient. Ils admettent ensuite que le chien a consommé des opioïdes récréatifs. Le chien réagit bien au traitement à la naloxone. Le couple et ses enfants sont soulagés et reconnaissants. Vous ne vous sentez pas à l’aise de faire des remontrances à ces personnes à propos des dangers des narcotiques récréatifs, cependant, avec deux jeunes enfants et l’incident du chien qui témoigne que ces drogues ne sont pas toujours entreposées de manière sécuritaire, il ne semble pas approprié de classer ce dossier comme un traitement réussi et de vaquer à vos activités comme si de rien n’était. **Quelles sont vos obligations professionnelles dans cette situation?**

Veterinarian detects failure on the part of a client to properly store opiates — A comment

The case presents as accidental ingestion of opioids. Unless you have definitive evidence that the clients intentionally administered non-prescribed controlled substances to the puppy, no legitimate case can be made for animal abuse or for you to report the incident as such.

By the same token, irrespective of your ‘discomfort’ with the situation, especially given the clients’ nervousness regarding the

An ethicist’s commentary on a veterinarian detecting failure on the part of a client to properly store opiates

"Aesculapian authority" is the authority inhering in a person by virtue of being societally recognized as a medical professional. The term, devised by sociologist Talcott Parsons, was originally intended to apply to human physicians. Aesculapian authority is the uniquely powerful authority vested in those that society perceives as healers, historically traceable to the time when medicine was inseparable from magic and religion.

As I explained in a 2002 AVMA Journal commentary (1), it is Aesculapian authority that licenses a medical practitioner to handle a patient with great intimacy. Physicians may probe all parts of the body of patients of either gender, with barely a “by your leave” — "they tell a patient they must enter an otherwise forbidden area rather than ask for permission. Aesculapian authority confers the sick role, allowing patients to escape from responsibilities of work, school, or family. Such authority also compels patients to ingest unpalatable medications; change their eating or sleeping habits; submit to moral lectures on child rearing; surrender blood, urine, or fecal material; be immobilized; undergo surgery preceded by imposed loss of consciousness; or even change their temperament. What would be dismissed as torture in the absence of Aesculapian authority is meekly accepted by even the most powerful in its presence." As one physician once told me, “As a physician, I can get almost anyone to do whatever I tell him or her” (1).

Though rarely discussed in veterinary circles, virtually all veterinarians are familiar with how this authority manifests itself. Veterinarians, like physicians, are approached by virtual strangers asking for information about an affliction they have been diagnosed with. I remember talking to a Wyoming rancher who lived hundreds of miles away from the nearest physician.
I asked him what he does with medical problems. He said, “Hell, if I get a fracture or a severe cut, for example from barbed wire, I call my vet! After all, flesh is flesh and bone is bone. And if the vet is good enough to treat my animals, he or she is good enough to treat me!”

Bearing this thought in mind, we can approach the situation at issue here. If the veterinarian is morally certain that the dog acquired the opiates either directly from the owners, or by heedlessness on the part of the owners in failing to keep the drugs away from animals or children, there is a very strong presumption for the veterinarian to intercede. After all, the situation could well have resulted in tragic consequences for the children or the animal. As a medical professional cognizant of the awful results that could ensue from failure to store opiates in a secure location that cannot be breached by children or animals, it is unquestionably your duty to educate the clients in highly dramatic terms of the potential dire consequences. This duty is quite simply a consequence of your special knowledge and deserves to be fulfilled in the strongest possible terms based in your Aesculapian authority. I would further argue that failure to make this point would be an abrogation of the responsibility flowing from a veterinarian’s authority and that he or she would probably be morally and legally justified in reporting the cavalier disposition of the drug.

Borrowing a page from one of my veterinarian friends, he approaches suspected animal abuse as follows: he calls the client into his office while holding a folder. He tells the client that the folder is an account of the situation which could be submitted to authorities. He asks the clients to bring the dog in periodically so he can check for signs of abuse. If there are no signs, he retains the file. If there are signs, he passes it on to authorities.

One could deploy a similar strategy in the case of the clients heedless of secreting drugs in a place inaccessible to animals or children. I would also request that they sign a “contract” agreeing to sequester the drugs. Such a strategy can underscore the seriousness of the situation. If I were suspicious that this sort of thing is a regular occurrence in the household in question, I would ask the owners to bring in the animal for a quick inspection on a regular basis in order to assure that they have grasped the point. Although the chances of your detecting something are virtually nil, your Aesculapian authority coupled with the threat might do the job. I would not charge them a fee so as not to appear self-serving. By acting in this way, you would stress the gravity of the situation, and help avoid potential tragedy.

Reference

Bernard E. Rollin, PhD

Animal Health Information Sources

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

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

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

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

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

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


7. University of PEI — Diagnostic Services (Newsletter)
   http://www.upei.ca/avc/diagnostic-services/newsletters
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Instructors
Michael Lappin, DVM, DACVIM (SAIM)
Catriona MacPhail, DVM, PhD, DACVS

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Quiz Corner

Test éclair

1. A 12-year-old toy poodle presents with anorexia, polyuria/polydipsia, bone pain, and epistaxis. Laboratory testing shows a nonregenerative, normocytic anemia; hypercalcemia; and a monoclonal gammopathy. The most likely diagnosis is which of the following?
   A. Chronic granulocytic leukemia
   B. Multiple myeloma
   C. Myelodysplastic syndrome
   D. Immune-mediated hemolytic anemia
   E. Babesiosis

2. An 8-year-old, 350-kg, Arabian gelding is referred to a clinic for evaluation and treatment of an infected wound. Treatment on the farm included gentamicin at 4 mg/kg intravenously 4 times a day for 10 days. Upon plasma biochemical analysis, the horse is azotemic [creatinine 6.8 mg/dL (601 μmol/L)]. Which of the following is the most likely explanation for these findings?
   A. Acute tubular necrosis
   B. Chronic tubular necrosis
   C. Acute glomerulonephritis
   D. Chronic glomerulonephritis
   E. Active pyelonephritis

3. Laboratory findings consistent with malignancy include which of the following?
   A. Normal ionized calcium concentration with elevated parathyroid hormone (PTH) concentration.
   B. Elevated ionized calcium concentration with elevated PTH concentration.
   C. Elevated ionized calcium concentration with suppressed PTH concentration.
   D. Low ionized calcium concentration with low-normal concentration of PTH.
   E. Normal ionized calcium concentration with normal concentration of PTH.

1. Un Caniche nain âgé de 12 ans souffre d’anorexie, de polyurie/polydipsie, de douleur osseuse et d’épistaxis. Les résultats du laboratoire révèlent une anémie normochrome non régénérative, une hypercalcémie et une gammapathie monoclonale. Lequel des diagnostics suivants est le plus probable?
   A. leucémie myéloïde chronique;
   B. myélome multiple;
   C. syndrome myélodysplasique;
   D. anémie hémolytique à médiation immunitaire;
   E. babésiase.

2. On conduit à une clinique un cheval hongre de race Arabe âgé de 8 ans et pesant 350 kg, pour examen et traitement d’une plaie infectée. Le traitement à la ferme comprenait 4 mg/kg de gentamicine par voie intraveineuse, 4 fois par jour durant 10 jours. À l’examen biochimique du plasma, le cheval démontre de l’urémie (créatinine 601 μmol/L [6,8 mg/dL]). Laquelle des explications suivantes est la plus probable?
   A. nécrose tubulaire aiguë;
   B. nécrose tubulaire chronique;
   C. gloméronéphrite aiguë;
   D. gloméronéphrite chronique;
   E. pyélonéphrite active.

3. Les résultats de laboratoire compatibles avec l’état de malignité comprennent lesquelles des concentrations suivantes?
   A. concentration normale de calcium ionisé avec concentration élevée de la parathormone (PTH);
   B. concentration élevée de calcium ionisé avec concentration élevée de la PTH;
   C. concentration élevée de calcium ionisé avec concentration diminuée de la PTH;
   D. concentration basse de calcium ionisé avec concentration basse normale de la PTH;
   E. concentration normale de calcium ionisé avec concentration normale de la PTH.

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ZYCORTAL®
Hidden Disease. Visible Answer.
4. Which of the following is the treatment of choice for mucoceles?
   A. Drainage and application of warm compresses
   B. Surgical excision of the affected salivary gland
   C. Antibiotics
   D. Phenobarbital

5. A cow presents with one markedly swollen quarter of the mammary gland, fever (T = 104.3°F), tachycardia (HR = 115 bpm), severe dehydration (skin tent = 5 seconds), and depression (recumbent, unable to rise). Which of the following is correct regarding this case?
   A. Milk culture results will grow a Gram-negative organism.
   B. Recumbency should be corrected by IV 23% calcium borogluconate infusion.
   C. Serum electrolyte measurement should precede fluid selection.
   D. If pregnant, the risk of abortion should be discussed with the producer.
   E. Antibiotic therapy should be by the intramammary route alone.

(See p. 850 for answers./Voir les réponses à la page 850.)
Annual Awards Ceremony Recognizes CVMA Members for Outstanding Contributions to Veterinary Medicine

For over 30 years, the Canadian Veterinary Medical Association (CVMA) has proudly recognized its members for their exceptional contributions to the veterinary profession, and animal health and welfare. This year was no exception as individuals were honored at the CVMA Awards Ceremony in Vancouver, British Columbia, which took place during the 2018 CVMA Convention in July.

Dr. Matt Read was honored with the CVMA Small Animal Practitioner Award, sponsored by Petsecure Pet Health Insurance, for his passion and enthusiasm for anesthesia and pain management. Dr. Read graduated with distinction from the Western College of Veterinary Medicine (WCVM) in 1998. Following graduation, he completed a residency in veterinary anesthesia and a Master’s of Veterinary Science in wildlife anesthesia, also at WCVM. Dr. Read became board certified with the American College of Veterinary Anesthesia and Analgesia (ACVAA) in 2002. Following his residency, he taught at the University of Georgia for 2 years before returning to Canada and developing and supervising the anesthesia services in 2 referral practices in Toronto and Calgary between 2003 and 2010. In 2010, Dr. Read joined the University of Calgary where he has been teaching in the DVM program and continuing to practice clinical anesthesia in Calgary and around southern Alberta. He has delivered over 100 lectures and workshops in Canada and internationally, and is currently preparing the 2nd edition of a text book, Small Animal Regional Anesthesia and Analgesia. Later this summer, Dr. Read will join MedVet, a large group of specialty hospitals, in Columbus, Ohio. He will split his time between supervising the anesthesia service in Columbus and providing anesthesia and educational outreach to community veterinarians and MedVet’s other referral centres across the United States.

Dr. Helene Van Doninck, was awarded the CVMA Humane Award, sponsored by Merck Animal Health, for her dedication to caring for injured wildlife. Dr. Van Doninck grew up in New Waterford, Nova Scotia, and was drawn to veterinary medicine from an early age. She graduated from the Atlantic Veterinary College (AVC) in 1991 and returned to Nova Scotia after working in Ontario and Newfoundland. She enjoyed small...
animal practice; however, wildlife was always her passion and she pursued continuing education in this field. In 2001, she co-founded the Cobequid Wildlife Rehabilitation Centre on her own property where, to this date, she provides volunteer veterinary care and rehabilitation to over 400 injured and orphaned wildlife each year. Dr. Van Doninck is particularly interested in birds of prey, oil contamination of birds, and lead poisoning in bald eagles. She has been working with hunters and anglers for the past 10 years to encourage voluntary transition away from lead-based ammunition and fishing tackle, for the health of both humans and wildlife. She firmly believes wildlife is valuable and actively encourages other veterinarians to develop wildlife-friendly practices.

The Merck Veterinary Award, sponsored by Merck Animal Health, was given to Dr. Kathleen Parker for her commitment to the improvement of animal health. After graduating from the Western College of Veterinary Medicine (WCVM) in 1981, Dr. Parker established a mixed animal practice in central Alberta. What started as a large animal ambulatory service has evolved into a comprehensive mixed animal practice that continues to this day at a clinic in Three Hills, Alberta, where she also runs a purebred Suffolk Sheep Farm with her husband. Dr. Parker remains a valued keynote speaker at symposiums, workshops, and conferences across Canada. She strives to encompass the overall scope of the animal health industry by empowering producers, students, and clients to learn and understand the purpose and benefit of livestock welfare. She is a veterinarian who teaches those around her because it is her belief that knowledge is power.

The Practice of the Year Award, sponsored by Scotiabank, was presented to the Kannon Animal Hospital, established in 2012, because of its commitment to ecohealth and environmental responsibility. The hospital team’s ongoing goal is to minimize the negative impact the existence of the hospital and the practice of veterinary medicine has on the environment and ecosystem. They recognize the inextricable links between the health of the environment and the people and pets for which they care; being friendly to the earth correlates to being friendly to their clients. It began with recycling/renovating a building particulièrement aux rapaces, à la contamination des oiseaux par le pétrole et à l'empoisonnement par le plomb des pygargues à tête blanche. Elle travaille avec les chasseurs et les pêcheurs depuis dix ans afin d'encourager l'abandon volontaire des munitions et des articles de pêche au plomb pour protéger la santé des humains et de la faune. Elle croit fermement que la faune est précieuse et elle encourage activement les autres vétérinaires à développer des pratiques conviviales pour la faune.

Le Prix vétérinaire Merck, qui est commandité par Merck Santé animale, a été présenté à la Dr. Kathleen Parker pour son engagement en vue d'améliorer la santé animale. Après l'obtention de son diplôme au Western College of Veterinary Medicine (WCVM) en 1981, la Dr. Parker a fondé une pratique mixte dans le centre de l'Alberta. Ce qui a commencé par un service ambulatoire pour grands animaux a évolué en une pratique mixte complète qui est toujours une clinique en exploitation à Three Hills, en Alberta, où elle gère aussi une ferme de moutons de race Suffolk avec son mari. La Dr. Parker demeure une conférencière invitée prisée dans les symposiums, les ateliers et les congrès au Canada. Elle s'efforce d'inclure la portée complète de l'industrie de la santé animale en habitant les producteurs, les étudiants et les clients à apprendre et à comprendre le but et les avantages du bien-être du bétail. Elle est une vétérinaire qui enseigne aux personnes autour d'elle parce qu'elle croit que le savoir représente le pouvoir.

Le Prix de la pratique de l’année, qui est commandité par la Banque Scotia, a été décerné à la clinique Kannon Animal Hospital, qui a été établie en 2012, en raison de son engagement envers la santé des écosystèmes et la responsabilité environnementale. Le but de l’équipe de la clinique consiste à minimiser l’impact négatif de l’existence de la clinique et de l’exercice de la médecine vétérinaire sur l’environnement et l’écosystème. La pratique reconnaît les liens inextricables entre la santé de l’environnement et les personnes et les animaux de compagnie qui sont soignés, car la convivialité avec la Terre est liée à la convivialité avec les clients. Cette mission a commencé par le recyclage et la rénovation d’un bâtiment de la manière la plus écoresponsable possible avec les moyens disponibles et elle se poursuit aujourd’hui dans la prise de décisions — qu’il s’agisse de fournitures médicales,
in the most eco-responsible way they could with the means at hand, and continues to the present day wherein the decisions they make — ranging from hospital supplies, veterinary treatment, and energy sources — are based on sustainability without compromising overall care.

Dr. Carlton Gyles was honored with a CVMA Life Membership this year for his unwavering commitment to the practice of veterinary medicine and to the CVMA since graduating from the Ontario Veterinary College (OVC) in 1964. After completing his PhD from the University of Guelph in 1968, he received a Medical Research Council post-doctoral fellowship to conduct research in England and Denmark. In 1969 he returned to the OVC as a faculty member and taught bacteriology to DVM and graduate students, supervised MSc and PhD students, and conducted research. Much of his research was on how the bacterium *E. coli* causes disease in animals and, working with Dr. Don Barnum, he discovered the *E. coli* heat labile enterotoxin and its role in diarrheal disease. He was dean of Graduate Studies from 1981 to 1986, chair of the Department of Veterinary Microbiology and Immunology from 1992 to 1996, chair of the Department of Pathobiology from 1996 to 1997, and interim dean of the OVC from 2004 to 2005. He is the recipient of several awards from the OVC and the microbiology community in Canada and the United States. In 2006, he was a founding member of the Canadian Academy of Health Sciences. He has been a CVMA member since graduation in 1964 and Editor-in-Chief of *The Canadian Veterinary Journal* for the past 10 years.

Dr. Barry Stemshorn was awarded the 2018 CVMA President’s Award for his decades of service to the veterinary community, research, policy, and to the CVMA. Upon graduation from the Faculty of Veterinary Medicine, Université de Montréal, in 1974, Dr. Stemshorn joined Agriculture Canada where he served in veterinary laboratory, policy, and operational roles including several executive positions in the Canadian Food Inspection Agency. During these years he developed scientific networks in Latin America and the Caribbean working with the United Nations University and the Inter-American Institute for Trade and Development vétérinaires et de sources d’énergie — qui sont basées sur la durabilité sans compromettre les soins généraux.


Le Prix du président de l’ACMV 2018 a été décerné au Dr. Barry Stemshorn pour ses décennies de service au sein de la collectivité vétérinaire, de la recherche, de l’élaboration de politiques et de l’ACMV. Après l’obtention de son diplôme à l’Université de Montréal en 1974, le Dr. Stemshorn s’est joint à Agriculture Canada où il a occupé des postes dans le laboratoire vétérinaire et la division d’élaboration de politiques et a ensuite tenu des rôles fonctionnels, y compris plusieurs postes de direction à l’Agence canadienne d’inspection des aliments. Durant ces années, il a établi des réseaux scientifiques en Amérique latine et dans les Antilles en travaillant avec l’Université des Nations unies et l’Institut interaméricain de coopération pour
Cooperation on Agriculture. Following a year with the cabinet secretariat of the Privy Council Office, Dr. Stemshorn joined Environment Canada as an assistant deputy minister to lead national programs to manage toxic substances and reduce air, water, and soil pollution from 2000 to 2006. As a senior fellow at the University of Ottawa from 2006 to 2015, Dr. Stemshorn co-authored a study for the Premier of China on mercury pollution in that country, and led the development of a Certificate Program in Regulatory Leadership for senior public servants, offered jointly with Carleton University. He continues to support the World Organisation for Animal Health (OIE) in the evaluation of national veterinary services. Dr. Stemshorn is a volunteer and donor for several environmental organizations, Veterinarians without Borders, and the CVMA; he is the treasurer for the CVMA. He was awarded the Queen Elizabeth II Golden Jubilee Medal in 2002 and Diamond Jubilee Medal in 2012 for his contributions to Canada.

The R.V.L. Walker Award is presented annually to the president of the Students of the CVMA (SCVMA) for his/her work to promote student interests in the Association. This award features 2 recipients — a plaque is presented to the president of the SCVMA and a cash award is made available to the veterinary college where the president is registered to provide financial assistance to a student veterinarian in need. The recipient of this year’s R.V.L. Walker Award plaque is Ms. Kira Moser from the University of Calgary, Faculty of Veterinary Medicine (UCVM). Ms. Moser grew up in Tottenham, Ontario before moving to Calgary, Alberta when she was 8 years old. She spent most of her early days at the barn with her horse and was involved in show jumping competitions during her pre-university days, through which she developed a passion for all animals. She took this passion and moved north to pursue an Animal Health degree from the University of Alberta in Edmonton. After spending 2 exciting summers working at an emergency animal hospital, Ms. Moser decided a career in veterinary medicine was right for her. She moved back to Calgary to join UCVM’s Class of 2019. In addition to her role as an SCVMA Committee representative, Ms. Moser is on the Wellness Weekend Planning Committee and is an executive member of UCVM’s Student Veterinary Emergency and Critical Care Society.

Nominations for the 2019 CVMA Awards will open in the fall of 2018. The submission deadline is January 31, 2019. Visit the CVMA website (www.canadianveterinarians.net/about/awards) to learn more.
CVMA’s Business Management Program Helps You Achieve a Successful Career and a Balanced Life

One of the CVMA’s 3 objectives is helping veterinarians achieve “a successful career and a balanced life.” Although achieving this state of balance may be considered a luxury by many practitioners, it is more easily attainable in profitable practices. The CVMA’s Business Management Program can help all members, regardless of employment type, achieve a successful career and a balanced life. Here’s how:

The CVMA’s Business Management Program helps practice owner/partners by:
• helping practices benchmark their financial performance and competitiveness, establish fees, and determine compensation and benefits levels for associate veterinarians and non-DVM staff through provincial veterinary economic surveys.
• publishing practice management articles in The Canadian Veterinary Journal that compare and analyze compensation, benefits, fees, inflation, budgets, and trends across the country and give advice on topics such as attracting clients and managing purchases.
• providing veterinarians easy access to pertinent online resources and information on personal financial management, veterinary business management, and client management through the CVMA’s online Career and Business Toolkit.
• giving a detailed personalized report, upon completion of the Practice Owners Survey, which provides general recommendations to help improve practice profitability.
• providing a practice value estimate, upon completion of the Survey, that provides an estimate of their practice worth based on profitability.

The CVMA’s Business Management Program helps associate veterinarians by:
• investigating all aspects of compensation and benefits through the Associate Survey, which also evaluates the impact of elements such as type of practice, years in practice, location, types of compensation, etc.
• producing the resulting annual Report on Compensation and Benefits for Associate Veterinarians as an important benchmarking tool to compare hours worked, incomes and benefits across the province and across Canada.

Le Programme de gestion commerciale de l’ACMV vous aide à obtenir une carrière prospère et une vie équilibrée

L’un des trois objectifs de l’ACMV consiste à aider les vétérinaires à obtenir une carrière prospère et une vie équilibrée. Même si l’atteinte de cet équilibre peut être considérée comme un luxe par beaucoup de praticiens, elle est beaucoup plus facile dans les cliniques rentables. Le Programme de gestion commerciale de l’ACMV peut aider tous les membres, sans égard au type d’emploi, à obtenir une carrière prospère et une vie équilibrée. Voici comment :

Le Programme de gestion commerciale de l’ACMV aide les propriétaires de pratique et les associés :
• en appuyant les pratiques en vue de réaliser une évaluation comparative de leur rendement financier et de leur compétitivité, d’établir les tarifs et de déterminer les niveaux de rémunération et d’avantages sociaux pour les vétérinaires salariés et les employés non-vétérinaires lors des sondages économiques auprès des associations provinciales de médecins vétérinaires.
• en publiant des articles sur la gestion d’une clinique dans La Revue vétérinaire canadienne qui comparent et analysent la rémunération, les avantages sociaux, les tarifs, les budgets et les tendances au pays et donnent des conseils sur des sujets comme la façon d’attirer des clients et la gestion des achats.
• en fournissant aux vétérinaires l’accès facile à des ressources et à de l’information en ligne pertinentes sur la gestion des finances personnelles, la gestion d’une clinique vétérinaire et la gestion de la clientèle par l’entremise de la Trousse d’outils pour la carrière et les affaires en ligne de l’ACMV.
• en communiquant un rapport personnalisé détaillé, après avoir répondu au Sondage auprès des propriétaires de pratique, qui fournit des recommandations générales afin de contribuer à l’amélioration de la rentabilité de la pratique.
• en fournissant une estimation de la valeur de la pratique, après avoir répondu au Sondage auprès des propriétaires de pratique, qui fournit une estimation de la valeur de la pratique fondée sur la rentabilité.

Le Programme de gestion commerciale de l’ACMV aide les vétérinaires salariés :
• en examinant tous les aspects de la rémunération et des avantages sociaux dans le cadre du Sondage auprès des vétérinaires salariés, qui évalue aussi l’impact d’éléments comme le type de pratique, les années d’expérience, l’emplacement, les divers types de rémunération, etc.
• en produisant le Rapport annuel sur la rémunération et les avantages sociaux des vétérinaires salariés, qui est basé sur le sondage, en tant qu’important outil d’évaluation comparative afin d’examiner les heures travaillées, les revenus et les avantages sociaux dans la province et au Canada.

Le Programme de gestion commerciale de l’ACMV aide les vétérinaires du gouvernement, de l’industrie et des universités :
• en réalisant des sondages économiques annuels qui permettent à ces vétérinaires de comparer leurs heures de travail et les avantages sociaux avec ceux de leurs collègues.
The CVMA’s Business Management Program helps veterinarians in government, industry, and academia by:

- conducting national economic surveys that allow these veterinarians to compare their earnings, hours and benefits with peers.

Economic success translates into quality medicine by enabling practices to provide optimal staffing and service, better equipment and facilities, and overall higher level patient care. The CVMA Business Management Program services are provided to CVMA members across the country in collaboration with the provincial veterinary medical associations and corporate sponsors.

Where can you access this service?

To access the most recent veterinary economic reports and previously published practice management articles
- Go to the website (www.canadianveterinarians.net);
- Log in using your user name and password;
- Click on the Practice & Economics tab and then Business Management.

If you do not have or forget your CVMA user name and/or password or have additional questions, please contact the CVMA (admin@cvma-acmv.org).

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If you do not have or forget your CVMA user name and/or password or have additional questions, please contact the CVMA (admin@cvma-acmv.org).

Check the Chip Day is August 15, 2018

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

The National Companion Animal Coalition (NCAC) established a review process to assess the conformity of RFID products and processes with the revised Canadian standard for electronic (microchip) identification of companion animals. Only those RFID products that have been submitted for review and have been deemed in conformity with the Canadian standard will be recognized as suitable for companion animal identification.

An updated NCAC list of recognized products can be found under the Practice & Economics tab and Practice Tools section of the CVMA website.

La journée de vérification de la puce est le 15 août 2018


La Coalition nationale pour les animaux de compagnie (CNAC) a établi un processus afin d’évaluer la conformité des produits et des processus RFID à la norme canadienne révisée pour l’identification électronique (puce) des animaux de compagnie. Seuls les produits RFID qui ont été soumis aux fins d’examen et ont été jugés en conformité à la norme canadienne seront reconnus comme étant appropriés pour l’identification des animaux de compagnie.

Une liste mise à jour des produits reconnus par la CNAC se trouve sous l’onglet Pratique et finances, dans la section des Outils pour la pratique du site Web de l’ACMV.
If you have a client considering importing a dog into Canada from another country, ask them to book an appointment to discuss what should happen before and after the dog is imported. The Canadian Veterinary Medical Association (CVMA) created a checklist to help prompt the discussion. Input was provided by the CVMA’s Importation of Dogs Working Group.

The CVMA recognizes that education is a key element in the effective management of disease risk from importation of dogs and from the transboundary movement of dogs within Canada. To download the checklist and for more information, visit the Importation of Dogs into Canada section under Practice Tools on the CVMA website.
Vaccines Save Lives!
Animal Health Week 2018

The Canadian Veterinary Medical Association (CVMA) is reminding animal owners about the importance of vaccinations to protect animals against communicable diseases transferred between animals, as well as zoonotic diseases transferred from animals to humans, and bacteria carried by parasites that can cause disease and infections.

Under the campaign slogan Vaccines Save Lives! Animal Health Week, a national public awareness campaign running from September 30 to October 6, 2018, highlights the importance of protecting your animals from disease through vaccination. A vaccinated animal is a happy, safe, and healthy animal.

Dr. Troye McPherson, 2017–18 CVMA president, explains why her clinic is celebrating this year’s Animal Health Week.

“Many factors including the migration and expansion of parasite populations, the importation of domestic and farm animals from other countries, and the mutation and increased resistance of disease-causing bacteria have caused great concern in recent years for animal owners and veterinarians alike,” says Dr. McPherson. “Fortunately, at the same time, we have never been in a better position to protect the health and lives of the animals in our care because of the advances in animal healthcare and vaccinations. Vaccines are safe, effective, and protect animals against disease. We’re celebrating Animal Health Week at our clinic because vaccines truly do save lives.”

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

Our generous supporters
Generous support of the 2018 Animal Health Week campaign is provided by Principal Sponsor, Petsecure, Program Plus Sponsor, Merck, and Program Sponsor, iFinance Canada (Petcard). This month, we invite you to learn more about our Program Sponsor, Petcard.

A message from Petcard
Petcard, Canada’s premier veterinary procedure financing option, has been enabling pet owners across the country to prioritize the health of their pets for over 20 years. Disease prevention and immunization are critical in ensuring healthy and happy pets; vaccines save lives!

Les vaccins sauvent des vies!
Semaine de la vie animale 2018

L’Association canadienne des médecins vétérinaires (ACMV) rappelle aux propriétaires l’importance des vaccins afin de protéger les animaux contre les maladies transmissibles entre les animaux ainsi que les zoonoses transférées des animaux aux humains et les bactéries transmises par les parasites qui peuvent causer des maladies et des infections.

Sous la bannière du slogan Les vaccins sauvent des vies!, la Semaine de la vie animale, une campagne nationale de sensibilisation du public qui se déroule du 30 septembre au 6 octobre 2018, souligne l’importance de protéger vos animaux contre les maladies en les vaccinant. Un animal vacciné est un animal heureux, protégé et en santé.

La Dr. Troye McPherson, présidente 2017–2018 de l’ACMV, explique pourquoi sa clinique célèbre la Semaine de la vie animale de cette année.

“Beaucoup de facteurs, incluant la migration et l’expansion des populations de parasites, l’importation d’animaux domestiques et agricoles provenant d’autres pays ainsi que la mutation et la résistance accrue des bactéries causant des maladies, ont suscité des préoccupations importantes au cours des récentes années tant pour les propriétaires d’animaux que pour les vétérinaires», dit la Dr. McPherson. «Heureusement, en même temps, nous n’avons jamais été dans une meilleure position pour protéger la santé et la vie des animaux confiés à nos soins en raison des progrès réalisés dans les soins aux animaux et la vaccination. Les vaccins sont surs, efficaces et ils protègent les animaux contre la maladie. Nous célébrons la Semaine de la vie animale à notre clinique parce que les vaccins sauvent vraiment des vies.»

Nous vous invitons à partager vos célébrations sur Facebook, Twitter et Instagram en vous servant du mot-clic #Semainedelavieanimale.

Nos généreux commanditaires
Un généreux soutien de la campagne de la Semaine de la vie animale 2018 est fourni par le commanditaire principal, Petsecure, le commanditaire de programme plus, Merck, et le commanditaire de programme, iFinance Canada (Petcard). Ce mois-ci, nous vous invitons à en apprendre davantage à propos de notre commanditaire de programme, Petcard.
Un message de Petcard

Depuis plus de 20 ans, Petcard, l’option de financement des interventions vétérinaires par excellence au Canada, permet aux propriétaires d’animaux au pays de donner la priorité à leurs animaux de compagnie. La prévention des maladies et l’immunisation sont des éléments cruciaux afin d’assurer des animaux en santé et heureux et les vétérinaires placent souvent nos dépliants dans les trousses pour chiots et chatons qu’ils fournissent à leurs clients au moment du premier examen. Malheureusement, les soins aux animaux sont trop souvent considérés comme une dépense discrétionnaire et l’importance des vaccins doit donc être communiquée aux propriétaires d’animaux non seulement en ce qui a trait à la protection de la santé générale de l’animal mais aussi en tant qu’investissement. Les vaccins sauvent des vies, mais ils aident aussi les propriétaires d’animaux à la longue en prévenant les affections et les maladies qui peuvent exiger des interventions et des traitements coûteux à l’avenir. Petcard a aidé des milliers de propriétaires d’animaux à choisir les options de traitement préventif, comme l’immunisation, en atténuant l’aspect financier initial et en persuadant les clients conscients des coûts à envisager ces traitements comme nécessaires au lieu de facultatifs. Petcard est aussi un partisan et défenseur de longue date de l’adoption des régimes de bien-être à l’échelle nationale, car nous reconnaissions l’importance de la prévention et des examens réguliers pour l’état de santé général des animaux.

Petcard est un partisan de longue date de l’ACMV et l’entreprise est fière d’être le commanditaire de programme de l’Animal Health Week de cette année. En partenariat avec l’ACMV, nous sommes fiers d’offrir le Programme Petcard de l’ACMV à tous les membres actuels de l’ACMV. Les membres qui s’inscrivent au programme peuvent maintenant offrir à leurs clients des options de financement flexibles afin que leur animal puisse obtenir les soins recommandés dont il a besoin. Le Programme Petcard de l’ACMV offre un éventail d’avantages excitants pour les cliniques membres de l’ACMV, comme des récompenses exclusives et de nouvelles occasions d’optimisation des moteurs de recherche. Si vous aimeriez vous inscrire ou en apprendre davantage à propos de l’excitant Programme Petcard de l’ACMV, veuillez nous contacter soit en appelant au 1-888 689-9876 ou par courriel (info@petcard.ca).
Appel de mises en candidatures — Membre du Conseil de l’Ontario (2019–2021)


Les règlements administratifs de l’ACMV prévoient l’élection d’un membre du Conseil de l’ACMV dans les provinces où les cotisations de l’ACMV ne sont pas perçues par l’association provinciale. Un membre de l’ACMV est admissible à l’élection au Conseil de l’ACMV si : i) il est résident de la province pour laquelle il est mis en candidature; ii) il est mis en candidature par deux (2) membres de l’ACMV en règle qui résident dans cette province; iii) il accepte la mise en candidature; et iv) il est membre en règle de l’ACMV.

L'élection se déroulera uniquement par voie électronique.

Les mises en candidature doivent être soumises en remplissant le formulaire prévu à cet effet. Les membres peuvent télécharger le formulaire PDF à remplir en ligne au (www.veterinairesaucanada.net/cvma-bylaws) et l’envoyer au Secrétariat de l’ACMV par courriel (admin@cvma-acmv.org) avant le 31 août 2018.

Chaque mise en candidature doit être appuyée par deux (2) membres en règle de l’ACMV et contresignée de la signature électronique du candidat. Si l’il y a plus d’un candidat, tous les membres de l’ACMV en Ontario seront avisés et recevront des instructions sur la façon de s’inscrire pour voter par voie électronique.
Case Report  
Rapport de cas

Massive uterine lipoleiomyoma and leiomyoma in a miniature poodle bitch

Aaron Percival, Ameet Singh, R. Alex zur Linden, Gwyneth Watrous, Steven Patten, Alexander Valverde, Emily Ratsep

Abstract — A 15-year-old, intact, female miniature poodle was presented for further evaluation of a large abdominal mass. Computed tomography was conducted to determine the origin of the mass and 2 large uterine masses were discovered. Ovariohysterectomy was performed and histopathological evaluation revealed a massive uterine lipoleiomyoma (27 × 17 × 15 cm), the largest recorded in the veterinary literature, and a smaller leiomyoma (7 × 5 × 4 cm).

Résumé — Lipoléiomyome utérin massif et léiomyome chez une chienne Caniche miniature. Une chienne Caniche miniature intacte âgée de 15 ans a été présentée pour une évaluation approfondie d’une grosse masse abdominale. Une analyse par tomodensitométrie a été réalisée afin de déterminer l’origine de la masse et deux grandes masses utérines ont été découvertes. L’ovariohystérectomie a été réalisée et l’évaluation histopathologique a révélé un lipoléiomyome utérin massif (27 × 17 × 15 cm), le plus gros jamais consigné dans la littérature vétérinaire et un plus petit léiomyome (7 × 5 × 4 cm). (Traduit par Isabelle Vallières)

Can Vet J 2018;59:845–850

Neoplasia of the canine uterus is a rare occurrence in veterinary medicine, accounting for 0.3% to 0.4% of all canine tumors (1). The most common canine uterine tumors are leiomyomas, which are benign mesenchymal tumors most frequently observed in the vaginal tract of dogs (2). Leiomyomas are characteristically noninvasive, slow-growing tumors which can be difficult to distinguish from their malignant epithelial counterparts (leiomyosarcoma) without histological evaluation (2). Lipoleiomyomas are a rare variant of leiomyomas characterized by well-differentiated neoplastic smooth muscle cells and mature adipocytes (3,4). Only 1 case of canine uterine lipoleiomyoma has been reported (5); however, there are several reports in the human literature (6–9). The histogenesis of lipoleiomyomas is controversial, as adipose tissue is not native to the myometrium (4,10). In the human medical literature, several studies have shown that lipoleiomyomas may arise from metaplasia of pluripotent mesenchymal cells or by a direct metaplasia of smooth muscle cells (4,10).

Clinical signs reported in dogs related to uterine tumors include abnormal estrus cycles, tenesmus, stranguria, and abdominal distension from large space occupying lesions (5,11,12). Given their benign nature, lipoleiomyomas and leiomyomas offer a good long-term prognosis with successful surgical excision (2).

Diagnostic imaging is an important step in determining the tissue of origin of abdominal masses and subsequent planning for treatment. However, the size and nature of large uterine masses can make interpretation of abdominal radiographs and ultrasonography challenging. Large uterine masses may be seen as poorly demarcated, soft-tissue opacities in the caudal abdomen, whereas smaller masses may not be seen at all radiographically (13). Ultrasonography has successfully determined the tissue of origin in smaller uterine masses (up to 11 cm × 7 cm in 1 report) (13). However, with increasing size of a soft-tissue mass, the ability to locate the tissue of origin can become more difficult with radiography and ultrasound (6,13). Cross-sectional imaging such as computed tomography (CT) provides additional imaging options for diagnosis of uterine tumors. These modalities can provide further detail into the tissue of origin and assist in clinical decision-making.

This report details a case of a 15-year-old poodle with a massive uterine lipoleiomyoma and leiomyoma. To the authors’ knowledge, this report describes the largest lipoleiomyoma reported in the veterinary literature.

Case description

A 15-year-old, 8.3-kg, intact, miniature poodle bitch was presented to the referring veterinarian for complaints of a distended abdomen of 4 days’ duration and loss of the ability to jump. The dog had its last estrus cycle 2 mo earlier and became pseudopregnant. Physical examination revealed a markedly distended abdomen and abdominal palpation discovered a large mass occupying the entire abdomen. The remainder of the physical examination...
was unremarkable. Abdominal radiographs and ultrasonography as well as a complete blood (cell) count (CBC) and serum biochemical profile were performed. Blood analysis revealed a mildly elevated blood urea nitrogen [BUN; 13.8 mmol/L, reference range (RR): 2.1 to 11.1 mmol/L] and a mild leukocytosis (16 × 10⁹/L, RR: 4 to 15.5 × 10⁹/L) with mild neutrophilia (13.3 × 10⁹/L, RR: 2.06 to 10.6 × 10⁹/L). No other blood abnormalities were observed. Abdominal radiographs revealed a large, soft-tissue opacity mass (~26 × 12 cm) in the abdomen extending from the liver to the pubis, and displacing the bowel dorsally (Figure 1). Prominent teats were also noted. Cursory abdominal ultrasound examination revealed a large fluid-filled mass, the origin of which could not be ascertained.

Based on the findings of a large abdominal mass from an unknown location, exploratory laparotomy was recommended by the referring veterinarian. The following day, the patient was routinely anesthetized and a ventral midline laparotomy was performed. A large, cystic mass was discovered; however, its tissue of origin could not be ascertained. The dog was hypotensive under general anesthesia, and, for this reason, the laparotomy incision was closed and the patient was recovered without attempting removal. The dog recovered uneventfully from anesthesia and was referred to the Ontario Veterinary College Health Sciences Centre (OVCHSC).

Upon presentation to the OVCHSC the dog was bright, alert, and responsive, weighing 8.3 kg, with all vital parameters within normal limits. Cardiothoracic auscultation revealed a grade 1-2/6 left systolic heart murmur; no other abnormalities were observed. Abdominal palpation revealed a large mass in the entirety of the abdomen. All palpable lymph nodes were soft and symmetric. A 6-cm ventral midline incision was present from the prior exploratory laparotomy. The remainder of the physical examination was unremarkable.

In order to further characterize the large abdominal mass and plan for surgery, CT of the abdomen was performed. The following day the dog was routinely anesthetized and an abdominal CT revealed a large, fluid-filled (10 Hounsfield units, HU) mass with soft tissue septations, occupying approximately 60% of the abdomen and extending from the liver to the pubis along the ventral abdomen (Figure 2). A small soft tissue dense mass (35 HU) was present in the left lateral abdomen that exhibited contrast enhancement (64 HU), and arose from the cranial extremity of the right uterine horn (Figure 2). A large blood vessel extended from this smaller soft tissue mass into the center of the larger fluid dense mass. The dog had stable cardiorespiratory function under anesthesia and surgical removal of the mass via ovariohysterectomy was recommended and carried out with the owner’s consent.

The prior ventral midline incision was enlarged and Balfour retractors were applied to improve abdominal exposure. A large, multi-lobulated cystic mass associated with the uterine body (Figure 3) was present and occupied most of the abdominal cavity. Both ovarian pedicles were sealed and divided using a vessel-sealing device (Ligasure PRECISE; Medtronic-Covidien, Mansfield, Massachusetts, USA). The uterine body was double ligated with 2 circumferential sutures (PDS; Ethicon, Edison, New Jersey, USA) and removed. The entire structure (mass and reproductive tract) weighed 2 kg. The remainder of the reproductive tract and the abdominal contents were unremarkable at the time of exploration. The reproductive tract was submitted for histopathology and the dog recovered from anesthesia.

Following surgery, the dog was allowed to recover in the intensive care unit on a fentanyl continuous rate infusion [2 to 6 µg/kg body weight (BW) per hour], IV and was discharged from hospital 1 d after surgery, weighing 6.5 kg. The dog was discharged with gabapentin (Auro Gabapentin; Aurolindo,

Figure 1. Left lateral (A) and ventral dorsal (B) abdominal radiographs of a 15-year-old intact female poodle. Note the large soft tissue opaque mass in the ventral aspect of the peritoneum extending from the liver to the pubis and displacing the intestines dorsally and to the right.
Figure 2. Abdominal computed tomography (CT) images following intravenous administration of contrast medium. A – Reformatted sagittal plane image of the mid-abdomen, demonstrating the extent of the large cystic mass (#). B – Reformatted sagittal plane image of the left side of the abdomen depicting the smaller solid mass (*). C, D – Transverse plane images at the level of the smaller solid mass (*). C – A connection of the smaller mass to the right uterine horn (arrowhead) can be seen and a vessel extends into the larger cystic mass from the uterus (arrow). E – Dorsal plane reformatted image, depicting a large vessel extending from the uterus into the large cystic mass (arrow). # – lipoleiomyoma; * – leiomyoma.
Woodbridge, Ontario), 100 mg, PO, q8h, and received a sustained-release injection of buprenorphine (Vetergesic; Champion Alstoe Animal Health, Whitby, Ontario), 0.2 mg, before discharge.

Histopathology
Gross examination of the submitted tissue revealed a large 27 × 17 × 15 cm soft, ovoid, fluctuant mass. Upon examination of the cut section, several cavities containing serous fluids were observed. The smaller 7 × 5 × 4 cm firm, tan, ovoid mass was associated with the uterine horn 3 cm distal to the larger mass. Samples of the remaining uterine tissue and the ovaries were also taken.

Histologic examination showed that both masses were located within the myometrium. The larger mass was surrounded by 100 μm of a thick, loose, fibrous connective tissue capsule. The spindle cell sheets contained within them mature adipose tissue and regions in which spindle cells were widely separated by clear spaces or myxoid intercellular matrix accounting for up to 20% of the mass. The neoplastic cells were well-differentiated, the nuclei were oval to elongate with small, distinct nucleoli without the presence of mitotic figures and negligible anisocytosis and anisokaryosis. This mass was diagnosed as lipoleiomyoma with myxoid features due to the adipose and myxoid tissue components (Figure 4). The smaller mass had similar neoplastic features, but lacked the adipocyte and myxoid characteristics. This mass was diagnosed as a leiomyoma.

Discussion
Canine uterine tumors are a rare finding, especially with the routine practice of early ovariohysterectomy (1). Lipoleiomyomas are characterized by well-differentiated neoplastic smooth muscle cells and mature adipocytes, and are considered a variant of leiomyoma which is the most common canine uterine neoplasia (3,4). Other reported canine uterine tumors include angioliopoleiomyoma, hemangiosarcoma, fibroma, fibroleiomyoma, fibromyoma, adenoma, endometrial polyp, adenocarcinoma, and plasmacytoma as well as other variants of leiomyoma (14–19).

This report details a massive lipoleiomyoma (27 × 17 × 15 cm) as well as a smaller leiomyoma (7 × 5 × 4 cm), that together with the reproductive tract weighed 2 kg. The signalment of this dog is consistent with the typical presentation of a middle-aged to older intact female animal (1). However, the size of the lipoleiomyoma is considerably larger than what has been reported in previous cases (3,5,13). As in dogs, giant lipoleiomyoma in humans are uncommon with ~140 cases reported in the medical literature. Leiomyomas (also termed fibroids) are common uterine tumors with a high incidence in reproductive women (7). A benign variant, lipoleiomyomas, are histologically characterized by variable amounts of adipocytes and smooth muscle cells. Similar to the dog in this report, in human lipoleiomyoma, the adipocytes do not have abnormal cytological characteristics and immunohistochemical staining is often performed to rule out well-differentiated liposarcoma (7). Several theories have been proposed as to the source of the adipose portion of the uterus during histogenesis. In early reports, the adipose tissue was thought to arise from degeneration of lipoleiomyoma, however, more recently, it has been considered that the adipose tissue results from direct metaplasia of the smooth muscle cells.
of leiomyoma, or due to abnormally located remnants of adipocytes in the embryo, or from multipotential undifferentiated mesenchymal cells (6–10). In women, uterine lipoleiomyomas are associated with vaginal bleeding, abdominal pain, and a palpable abdominal mass (6–10).

The effects of repeated exposure to steroid hormones produced during estrous cycles on the development of mammary carcinoma has been well-described in the veterinary literature (20,21). It is believed in the human and veterinary literature that steroid hormones (particularly estrogen) play a role in the formation of uterine leiomyomas (11,22–24). Miniature potbelly pigs have been shown to develop uterine leiomyomas with similar frequency, presentation, lesions, and effects of parity as in humans (25). Although miniature pigs have not been shown to develop lipoleiomyomas, they provide a promising model for the study of hormonal influence on formation of uterine tumors (25). In the human literature, it is suggested that giant leiomyomas may be linked to altered lipid metabolism such as in diabetes mellitus, hypothyroidism, and menopause (7–10). The dog of this report did not have any co-morbidities or metabolic abnormalities; however, further research into the formation of leiomyomas and their transformation into lipoleiomyomas may shed light on the influence of prolonged exposure to sex hormones in the development of canine uterine tumors.

This case demonstrates the difficulty of diagnosing uterine masses through abdominal radiographs, ultrasonography, and physical examination alone. A large uterine mass may be seen radiographically as a soft-tissue opaque abdominal mass with an unknown tissue of origin (26,27). Main radiographical differential diagnoses in a geriatric dog include neoplasia originating from the liver, spleen, lymphoid tissue, gastrointestinal tract, or reproductive tract. These differential diagnoses may lead an owner to believe that their animal’s prognosis is far graver than if a uterine leiomyoma is suspected, which emphasizes the importance of obtaining a definitive diagnosis. While ultrasound may be able to further characterize the origin of the mass, a diagnosis of leiomyoma/lipoleiomyoma can only be made following histopathological evaluation as many other uterine abnormalities may have a similar appearance (6,13).

Cross-sectional imaging is the next step in identifying the origin of the mass, should ultrasonography be inconclusive. As demonstrated by this case, cross-sectional imaging was imperative in helping to determine the tissue of origin of the mass and surgical resectability. Abdominal radiographs and ultrasound were ineffective in this regard. Once CT imaging was conducted, the 2 masses were traced to the uterus and successful surgical removal was performed following routine ovariohysterectomy. With definitive diagnosis only possible through histology, large uterine lipoleiomyomas present a clinical conundrum for owners with limited financial ability to pursue advanced diagnostic imaging. Biopsy or fine-needle aspiration may assist in diagnosis of uterine tumors and in clinical decision-making, especially as the diagnosis of leiomyoma would lead to a more positive prognosis (11,28,29). Misdiagnosis of these tumors may lead to euthanasia based on differential diagnoses with a poor long-term prognosis.

In conclusion, uterine leiomyomas and lipoleiomyomas are rare benign uterine tumors typically seen in middle-aged to older dogs. This is the first report describing a bitch with a uterine leiomyoma and myxoid lipoleiomyoma, as well as the largest lipoleiomyoma reported in the veterinary literature. Practitioners should consider benign uterine neoplasia in intact bitches presenting with large abdominal masses. Computed tomography is a superior diagnostic imaging choice in dogs with large abdominal masses.

References
Answers to Quiz Corner
Les réponses du test éclair

1. B) The most likely diagnosis is multiple myeloma.
   B) Le diagnostic le plus probable est le myélome multiple.

2. A) Aminoglycoside antibiotics are potentially nephrotoxic causing acute tubular necrosis. Toxicity is almost always the result of the cumulative effect, within the proximal tubular epithelial cells, of repeated administration of the aminoglycoside antibiotics.
   A) Les antibiotiques aminoglucosides sont potentiellement néphrotoxiques causant une nécrose tubulaire aiguë. La toxicité est presque toujours le résultat de l’effet cumulatif dans les cellules épithéliales des tubules proximaux de l’administration répétée des antibiotiques aminoglucosides.

   C) La réponse A suggère de l’hyperparathyroïdisme secondaire. La réponse B suggère de l’hyperparathyroïdisme primaire. La réponse D suggère de l’hypoparathyroïdisme primaire. La réponse E ne suggère aucun problème relié à l’homéostasie du calcium.

4. B) Surgical excision is the treatment of choice for mucoceles. Drainage and application of warm compresses are used for the treatment of sialoadenitis, as are antibiotics. Phenobarbital is used for the treatment of sialoadenosis.
   B) L’excision chirurgicale est le traitement de choix des mucoceles. Le drainage et l’application de compresses chaudes sont utilisés pour le traitement de la sialoadénite, tout comme le sont les antibiotiques. Le phénobarbital est utilisé pour le traitement de la sialoadénose.

5. D) Prostaglandin from the inflammatory cascade can induce abortion, and since this will affect the animal’s future health and value, should be discussed early in the disease. Recumbency is probably due to sepsis, toxemia, dehydration, and shock. Although serum calcium concentrations in some cases of Gram-negative mastitis are low, they are just outside the normal reference range. For this reason, it would be dangerous to administer concentrated calcium solutions intravenously. Fluid therapy is important in treating cases like this; isotonic or hypertonic (8× isotonic) NaCl is often used. This does not require prior serum electrolyte measurement. Symptoms are not predictive of a causative organism with any useful accuracy. Intramammary antibiotic therapy is indicated for persistent (predominantly Gram-positive) infections; cows with systemic signs (such as this one) also require parenteral antibiotic therapy.
   D) Les prostaglandines provenant de la cascade inflammatoire peuvent causer un avortement et affecter la santé et la valeur futures de l’animal. Cette situation devrait être discutée tôt au début de la maladie. Le décubitus est probablement causé par la septicémie, la toxémie, la déshydratation et le choc. Bien que les concentrations de calcium sérique soient basses dans certains cas de mammite à Gram négatif, elles sont justes en dehors des valeurs normales de référence. Pour cette raison, il serait dangereux d’administrer des solutions concentrées de calcium par voie intraveineuse. La fluidothérapie est importante pour traiter des cas comme celui-ci; du NaCl isotonique ou hypertonique (8× isotonique) est souvent utilisé et n’exige pas de dosage antérieur des électrolytes sériques. Les symptômes ne constituent pas une valeur prédictive précise de la présence d’un organisme causal. Une antibiothérapie intra-mammaire est indiquée pour des infections persistantes (à prédominance d’organismes à Gram positif); les vaches présentant des signes généralisés (comme cette vache) demandent également une antibiothérapie parentérale.
Tonsillar plasmacytoma in a dog

Yoshimi Iwaki, Colleen Monahan, Rebecca Smedley, David Upchurch, Paulo Vilar-Saavedra

Abstract — A 10-year-old greyhound dog was presented because of an incidental finding of a tonsillar mass. Excisional surgical biopsy was performed and the dog was diagnosed with an incompletely resected plasma cell tumor. Adjuvant therapy was declined. One year later there was no local recurrence or distant metastasis of the mass or clinical signs associated with the tonsillar plasmacytoma.

Résumé – Plasmacytome tonsillaire chez un chien. Un chien Greyhound âgé de 10 ans a été présenté en raison de la découverte fortuite d’une masse tonsillaire. Une biopsie par excision chirurgicale a été réalisée et le chien a été diagnostiqué avec une tumeur à plasmocytes avec résection incomplète. Le traitement avec adjuvant a été refusé. Une année plus tard, il n’y avait aucune récurrence locale ou de métastase distante de la masse ou de signes cliniques associés au plasmacytome tonsillaire.

Extramedullary plasmacytomas (EMPs) are solitary plasma-cytic tumors of soft tissues. The most common locations in the dog are cutaneous and mucous membranes of the oral cavity, colon, and rectum (1). Other locations that have been reported include eye, genitalia, intracranial sites, larynx, liver, spleen, sinonasal cavity, stomach, third eyelid, trachea, and uterus (2–8). Typically, cutaneous and oral EMPs in dogs are benign and metastasis is rare (1). However, EMPs that arise from other locations (i.e., gastrointestinal tract) have been reported to have a different behavior with a tendency towards metastasis. Extramedullary plasmacytomas that arise from the tonsils are rare in dogs and their clinical behavior is unknown. In this report, we describe the clinical signs, examination findings, and outcome in a dog with EMP in the tonsil.

Case description

A 10-year-old, spayed female retired racing greyhound dog was initially presented to the referring DVM with an acute history of left-sided sialorrhea which was presumed to be related to dental disease. As the dog was undergoing tracheal intubation for anesthesia in preparation for a dental cleaning, a mass was discovered originating from the left tonsillar fossa, and the dog was referred to Michigan State University Veterinary Teaching Hospital (MSU-VTH) for further diagnostic work-up 2 wk later. On presentation at the MSU-VTH, the dog was bright, alert, and responsive. Peripheral lymph nodes were small and symmetrical, aside from the left mandibular lymph node which was subjectively slightly enlarged. Blood analysis consisting of complete blood (cell) count (CBC) and serum chemistry profile (i.e., total protein, albumin, globulin, alkaline phosphatase, alanine aminotransferase, aspartate aminotransferase, total bilirubin, urea nitrogen, creatinine, glucose, and electrolytes) were unremarkable. There was no evidence of abnormalities on 3-view thoracic radiographs. A fine-needle aspiration of the left mandibular lymph node was done. Cytopathologic evaluation of the left submandibular lymph node revealed reactive lymphoid hyperplasia.

The dog was anesthetized with midazolam (Novaplus, Eatontown, New Jersey, USA), 0.2 mg/kg body weight (BW), IM, and butorphanol (Akorn, Lake Forest, Illinois, USA) 0.2 mg/kg BW, IM as premedication, and propofol (Novaplus, Lake Zurich, Illinois, USA) IV as induction. Under general anesthesia, oral examination revealed a 6 cm × 4 cm × 3.7 cm soft tissue mass originating from the left tonsillar fossa and protruding into the oral cavity. Normal tonsillar tissue was not present within the fossa. The right tonsil was within normal limits, and there were no other abnormalities of the soft tissues of the oral cavity. The dog was intubated using an endotracheal tube. After the intubation, isoflurane and oxygen were used to maintain general anesthesia. Excisional surgical biopsy of the left tonsillar mass was completed using a vessel sealing device (Ligasure Precise; Valleylab, Boulder, Colorado, USA) and the tonsillar fossa epithelium was closed with absorbable suture (Monocryl Ethicon; Johnson & Johnson, Somerville, New Jersey, USA).
The dog recovered uneventfully after the procedure. Codeine (West-Ward Pharmaceuticals, Eatontown, New Jersey, USA), 1.25 mg/kg BW, PO, q8h, and Clavamox (Zoetis, Parsippany, New Jersey, USA), 15.6 mg/kg BW, PO, q12h, were prescribed for pain control and septic prophylaxis due to severe dental disease, respectively.

The tissue was fixed in 10% neutral buffered formalin for approximately 8 h. Tissue was trimmed and routinely embedded. Paraffin-embedded tissues were sectioned at 5 μm, mounted on frosted glass slides, routinely stained with hematoxylin and eosin (H&E), and examined by light microscopy. Sections were also immunolabeled using a mouse monoclonal anti-MUM-1 antibody (Dako Cytomation, Carpinteria, California, USA) and a rabbit polyclonal anti-CD20 antibody (Bioz Thermo Fisher Scientific Neomarkers, Palo Alto, California, USA).

Microscopic examination of the mass revealed a proliferation of neoplastic plasma cells. Neoplastic cells were round, had variably distinct cell borders, small to moderate amounts of eosinophilic cytoplasm, and contained coarsely stippled ovoid to reniform nuclei that were often peripheralized. There were occasional bi- and tri-nucleated cells (bar = 20 μm) (b). Hematoxylin and eosin (H&E). Immunohistochemically, neoplastic cells exhibit moderate to strong (arrows) nuclear labeling for MUM-1 (c) and are non-immunoreactive for CD20 (d). Rare individual B-cells show cytoplasmic labeling for CD20 (d). Diaminobenzidine chromogen (bar = 50 μm).

Immunohistochemistry was done to define the origin of these cells and showed that cells were immunoreactive for MUM-1 and non-immunoreactive for CD20, which was most supportive of a neoplasm of plasma cell histogenesis (9) (Figure 1c, d).

The owner did not want to pursue possible treatments but agreed to monitor the disease with frequent computed tomography (CT) scans and radiographs. A CT scan of the head and thorax was performed 10 wk after surgical biopsy. Mild hyperattenuation in the region of the right tonsil was noted with differential diagnoses of metastatic disease or reactive scar tissue from surgery.

After 10 mo, the dog was presented for a follow-up examination. She had been doing well at home between the recheck
times, and had unchanged activity level and normal appetite. The sialorrhea had completely resolved. The tonsils were evaluated by oropharyngeal scoping and there was no local recurrence on the left tonsil (Figure 2). The right tonsil was normal in size and shape. On a repeat CT scan of the head and thorax, there was no evidence of metastasis to the regional lymph nodes or lungs.

Discussion

Myeloma-related disorders arise when plasma cells or immunoglobulin-producing B-lymphocyte precursor lineage cells transform into a neoplastic population. Myeloma-related disorders include multiple myeloma (MM), EMP, IgM monoclonal gammopathy, solitary plasmacytoma, and Ig-secreting lymphomas and leukemias (1). Extramedullary plasmacytomas in dogs are most commonly found in the skin, oral cavity, and other parts of the alimentary tract (1).

Dogs with EMP of the alimentary tract and other abdominal organs treated with surgical excision alone or in combination with systemic chemotherapy can achieve long-term survival times (1). In the veterinary literature, 5.2% to 22% of EMPs occur in the oral cavity and lips in dogs (11–13). In the oral cavity, gingival and lingual EMPs are the most common, composing 54.8% and 37.8%, respectively (11). Oral EMPs are locally aggressive, often involving bony destruction, but rarely metastasize. Dogs with single and multicentric oral EMPs treated with surgical excision can achieve long-term survival times (1,13–15). However, dogs treated with only cytoreductive surgery have regrowth of the tumor at the median recurrence time of 50 d and the median survival time of dogs that had no treatment or incomplete surgical margins without any adjuvant therapy is 90 d (13). Similar to what has been observed in humans, progression from a cutaneous plasmacytoma to a plasma cell leukemia in dogs has rarely been reported and is associated with a poor prognosis (16). Oral EMPs can progress to infiltrative plasmacytosis in multiple organs (13).

In humans, 82.8% of cases of EMP occur in the upper aerodigestive tract. The most common subsites are nasopharynx and oropharynx, nasal cavity, and paranasal sinuses (17). Approximately, 10.5% involve the tonsil or soft palate. Nodal involvement of EMP in the upper aerodigestive tract was reported in 7.6% of cases (18). In addition, bilateral EMP of the palatine tonsils has been reported (19,20). After radiation and/or surgery as therapy for EMP in the upper aerodigestive tract, 61.1% of all patients had no recurrence or conversion to multiple myeloma. However, 22.0% of these patients had local recurrence of EMP and 16.1% were reported to have conversion to multiple myeloma (18). Surgery alone gives the best prognosis in cases of EMP in which complete resection is achieved. However, if complete margins are not obtained or if regional or distant metastasis has occurred, adjunctive therapy is recommended (18). Due to the risk of a poor cosmetic result with surgery, radiation therapy at a dose of 40 to 60 Gy over 4 to 6 wk has been recently used as a primary treatment. After radiation therapy, the estimated 10-year overall survival, disease-free survival, and multiple myeloma-free survival are reported as 68.4%, 49.3%, and 55%, respectively (17). The current National Comprehensive Cancer Network guidelines for MM recommend that follow-up imaging should be used in cases of solitary plasmacytomas only if clarification is required for changes on the imaging studies noted at baseline or if there is suspicion of disease progression in the form of new onset bone pain or positive laboratory test results (21).

Immunohistochemistry for CD20 and MUM-1 was used to confirm plasma cell histiogenesis. CD 20 is a transmembrane phosphoprotein predominantly expressed from the pre-B cell stage to the activated B-cell stage (22). Multiple myeloma oncogene 1 (MUM-1) is a family of transcription factors and is required for immunoglobulin light-chain rearrangement at the pre-B stage of lymphocyte maturation (23), and high levels of MUM-1 expression lead to plasma cell differentiation (24).

MUM-1 is a very specific marker for plasma cell tumors. However, some B-cell lymphomas will label for MUM-1 depending on their direction of differentiation. Histologic features must always be used in conjunction with immunohistochemical results to make a diagnosis. In a study assessing the immunohistochemical features of plasma cell tumors in dogs, 101 of 109 plasma cell tumors (92.7%) were immunoreactive for MUM-1, while only 21 (19.3%) were immunoreactive for CD20 (9). In this study, 10 B-cell lymphomas out of 139 nonplasmacytic tumors were immunoreactive for MUM-1, but these neoplasms should also be immunoreactive for other B-cell markers, including CD20 and CD79a (9). Based on the histomorphologic features combined with the immunohistochemistry results, the tonsillar mass in this case is consistent with a plasma cell tumor.

Prognostic factors are unknown for cutaneous plasmacytomas in dogs. Grades and proliferation rates did not correlate with prognosis (12,25). In 1 report, all dogs with local recurrence or metastasis had polymorphous-blastic types (12). In humans, age, solitary plasmacytoma of bone, larger size (> 5 cm), and the IgG-Pro monoclonal antibody against Ki-67 antigen (MB1) scores are reported as potential prognostic factors (26–28).
In this case, the right tonsil showed mild hyperattenuation on CT scan 10 wk after the surgery. However, 1 report revealed that there is no difference for attenuation between normal tonsils and tumors (29). Thus it is difficult to evaluate tonsils without histology. In human medicine, Fludeoxyglucose (18F) positron emission tomography (FDG-PET) permits a whole-body investigation with an overall sensitivity of 90% and specificity of 75% for the detection of myeloma lesions, which is superior to CT-scan and MRI (30). Thus it is difficult to evaluate tonsils without histology. In human medicine, Fludeoxyglucose (18F) positron emission tomography (FDG-PET) permits a whole-body investigation with an overall sensitivity of 90% and specificity of 75% for the detection of myeloma lesions, which is superior to CT-scan and MRI (30). However, 1 report revealed that FDG-PET had a prognostic value above MRI (31). We understand the suitability of using FDG-PET-CT scan in this case, as recommended initially by supervising clinicians. Unfortunately, the usage of FDG-PET scan is still limited in veterinary medicine and only explored in a limited number of neoplastic malignancies (i.e., hemangiosarcoma, osteosarcoma, lymphoma, mast cell tumor, feline squamous cell carcinoma, and fibrosarcoma) (32–34).

To our knowledge, canine tonsillar EMP is rare and its clinical behavior is not fully understood, especially after incomplete resection (35). After 1 1/2 y from diagnosis and resection, there is no clinical evidence of recurrence or distant metastasis. Extramedullary plasmacytomas may be considered as a differential diagnosis for dogs with a tonsillar mass.

References
Case Report  Rapport de cas

Chondroblastic osteosarcoma of the middle ear in a guinea pig (Cavia porcellus)

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Abstract — A 3-year-old intact female guinea pig (Cavia porcellus) was presented for acute anorexia. Medical and surgical treatments for cystitis and ovarian cysts, respectively, did not prevent continuous weight loss. Computed tomography and histopathological analysis revealed a chondroblastic osteosarcoma of the right middle ear, which has not been reported in this species.

Résumé — Ostéosarcome chondroblastique de l’oreille moyenne chez un cobaye (Cavia porcellus). Un cobaye (Cavia porcellus) femelle de 3 ans a été présentée pour une anorexie d’apparition aiguë. Malgré la prise en charge médicale et chirurgicale d’une cystite et de kystes ovariens, l’individu continuait de perdre du poids. L’examen tomodensitométrique et l’analyse histologique ont mis en évidence un ostéosarcome chondroblastique de l’oreille moyenne, ce qui n’a jamais été rapporté dans cette espèce.

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Case description

A 3-year-old intact female guinea pig (Cavia porcellus) was presented to the Exotic Animal Clinic of the University of Montreal with a 1-week history of partial anorexia with decreased urine and fecal output. The owner did not report any recent changes in the guinea pig’s environment, or any stressful event. The diet consisted of commercial guinea pig pellets and timothy hay ad libitum. Fresh fruits, vegetables, and herbs were offered daily and a water-soluble vitamin C supplement was added to the drinking water once weekly.

On physical examination, the guinea pig weighed 920 g with a body condition score of 3/5. Subtle enophthalmos of the right eye, without any other ocular abnormalities, was noticed. Oral examination revealed an abnormal occlusal plane of the last mandibular molars (M3) bilaterally without dental spicules. The caudal abdominal region was distended and painful on palpation. It was not possible to distinguish abdominal structures due to abdominal wall contraction from discomfort. The remainder of the physical examination was unremarkable and the guinea pig urinated while being palpated.

Initial differential diagnosis for gastrointestinal stasis and painful caudal abdomen included disorders of the urinary (urolithiasis, cystitis) or genital (ovarian cysts, neoplasia) tracts or less likely disorders of the digestive tract (fecal impaction). Initial diagnostic plan included urinalysis and abdominal ultrasound. Due to financial constraints, the owner elected to donate the animal to the Small Mammal Shelter of the University of Montreal.

Partial urinalysis was performed on a urine sample collected following micturition. Urine dipstick was positive for proteins (0.3 g/L), glucose (2.8 mmol/L), and bilirubin (1+). On examination of the sediment, 10 to 25 leucocytes were observed per high-power field (hpf), which was suggestive of cystitis.

The initial treatment plan consisted of subcutaneous fluids [100 mL/kg body weight (BW) per day], Lactate Ringer’s Solution (Rafter 8 Products, Calgary, Alberta) (1), meloxicam (Metacam; Apotex, Toronto, Ontario), 0.5 mg/kg BW, PO, q12h, trimethoprim-sulfamethoxazole (Novo-Trimel; Teva Canada, Toronto, Ontario), 30 mg/kg BW, PO, q12h and buprenorphine (Vetergesic; Alstoe Animal Health, Whitby, Ontario), 0.03 mg/kg BW, SC, q6h (2). The guinea pig was force-fed with Critical care powder (Critical care; Oxbow Animal Health, Murdock, USA), 60 mL/kg BW per day, q6h (1). As part of the routine admission protocol to the Shelter, a treatment for parasites (Selamectine, Revolution; Pfizer, Animal Health, Kirkland, Quebec), 16 mg/kg BW, was administered topically once.

On day 1, an abdominal ultrasound was conducted and showed changes consistent with mild cystitis. Bladder sludge and 1 bladder stone ventrally measuring 1.1 mm diameter were confirmed. Ultrasound also revealed the presence of ovarian...
cysts bilaterally and the appearance of the uterus was compatible with cystic hyperplasia. Mild gallbladder distension without concurrent signs of obstruction was also noted. Bacterial culture of the urine was not performed since antibiotic therapy had been initiated.

After 24 h of hospitalization, the guinea pig produced feces in small amounts and urinates normally. The guinea pig showed persistent dysorexia during the first week of medical management, although mild improvement in food consumption was observed. On day 7, the guinea pig weighed 975 g and assisted feeding was progressively decreased. The right enophthalmos initially observed appeared to have resolved.

On day 8, a recheck analysis on a urine sample collected by natural urination was within reference limits. From days 8 to 14, progressive weight loss was observed daily with a body weight decreasing to approximately 800 g. The patient remained alert, showed some interest in fresh food items but was not eating sufficiently on her own so assisted-feedings were adjusted.

On day 15 following initial presentation, a recheck ultrasound was performed without sedation. The mineralized calculus within the bladder was adhered to the ventral wall causing a mild focal deformation of the wall at the adhesion site. Other previous findings were unchanged. Although the guinea pig was alert and had an improved appetite that day, abdominal palpation was still painful. In order to address abdominal discomfort related to the ovarian cysts and fulfill the Shelter’s mission, an ovariectomy was scheduled. Prazosin (Teva-Prazosin; Teva), 0.5 mg/kg BW, PO, q24h, and tramadol (Summit Veterinary Pharmacy, Aurora, Ontario), 4 mg/kg BW, PO, q12h, were added to the previous treatments to reduce potential urethral hyperreflexia and improve analgesia with a multimodal approach, respectively (2).

On day 16, the guinea pig was in good general condition with a stable body weight allowing her to undergo surgery. Bilateral ovariectomy was conducted using a lateral flank approach (3). Following a 2-hour fasting period, (4,5) the guinea pig was sedated with a combination of midazolam (Midazolam; Sandoz, Boucherville, Quebec), 0.5 mg/kg BW, IM, buprenorphine (Vetergesic; Alstoe Animal Health), 0.05 mg/kg BW, IM, and ketamine (Narketan; Vétoquinol, Lavaltrie, Quebec), 5 mg/kg BW, IM (2). Anesthesia was induced and maintained with isoflurane (Isoflurane, USP; Fresenius Kabi Animal Health, Toronto, Ontario), 1% to 3% in oxygen delivered by facemask for the procedure. The CT imaging revealed a well-defined mineralized mass associated with the right tympanic bulla (Figure 1). This mass lesion extended from the tympanic bulla to the caudal aspect of the nasopharynx and displaced the soft tissues of the nasopharynx to the left. This mass was large (approximately 1.0 X 1.5 X 1.1 cm), well-circumscribed, and isolated. There was no visible soft tissue component with this mass. The right tympanic bulla contained fluid (Figure 1) and the left appeared normal. The external ear canals were unremarkable. There were no other significant findings.

Due to poor prognosis and unsuitability for adoption, the guinea pig was euthanized. Anesthesia was induced with isoflurane delivered by facemask until a surgical plane was reached and

Fine-needle aspiration of cysts before exteriorization of each ovary was not deemed necessary. Hemostasis was verified and the incision was closed routinely. Flumazenil (Flumazenil Injection USP; Pharmaceutical Partners of Canada, Toronto, Ontario), 0.01 mg/kg BW (3), was administered intramuscularly. Recovery from anesthesia was unremarkable. The guinea pig was alert, had a good appetite, and defecated and urinated normally the evening following surgery.

On day 19, a seromucous epiphora with mild ventral corneal opacification of the right eye was newly observed in addition to a mild enophthalmos. Tobramycin (Tobrex; Sandoz) was initiated every 8 to 12 h pending complete evaluation by an ophthalmologist. A corneal ulcer characterized by corneal degeneration associated with detachment of the ventral corneal epithelium was diagnosed in the right eye. Immature bilateral cataracts characterized by partial opacification of the periphery of the lens was also present. Ophthalmic treatment plan was changed to serum, artificial tears gel, and bacitracin-neomycin-polymyxin B (Vétoquinol) application every 6 h in the right eye.

At this time, 3 d after the ovariectomy, the guinea pig was clinically comfortable and there was no more abdominal pain. Although the animal was alert, had good appetite, and produced feces and urine normally, weight loss continued despite assisted feedings. On day 22, the guinea pig weighed 723 g.

The hypotheses for chronic weight loss in a guinea pig with an adequate appetite may include hyperthyroidism or neoplasia. No mass was palpable in the cervical region. In order to investigate these diseases, thyroxine (T4) hormone level was determined and a whole body tomodensitometric examination was performed.

The results of these tests indicated that the serum concentration of thyroxine hormone was low [6.2 nmol/L; reference interval (RI): 14.2 to 66.9 nmol/L], thus excluding hyperthyroidism (8).

Whole-body computed tomographic (CT) scan was performed using a third-generation, 16-slice helical CT scanner (HiSpeed ZXi; General Electric, Mississauga, Ontario). The following protocol was used to image the guinea pig: exposure 120 kVp and 250 mA, slice thickness 1.25 mm, slice interval 0.625 mm, pitch 0.938:1, display field-of-view (DFOV) 12 cm and including the entire reference phantom, speed 9.37 mm/rotation, number of rotations 1.0/s, matrix 512*512". Images were reformatted with a detail algorithm in sagittal and dorsal planes and 3D. The guinea pig was fasted for 1 h before induction and was maintained with isoflurane delivered by facemask for the procedure. The CT imaging revealed a well-defined mineralized mass associated with the right tympanic bulla (Figure 1). This mass lesion extended from the tympanic bulla to the caudal aspect of the nasopharynx and displaced the soft tissues of the nasopharynx to the left. This mass was large (approximately 1.0 X 1.5 X 1.1 cm), well-circumscribed, and isolated. There was no visible soft tissue component with this mass. The right tympanic bulla contained fluid (Figure 1) and the left appeared normal. The external ear canals were unremarkable. There were no other significant findings.

Due to poor prognosis and unsuitability for adoption, the guinea pig was euthanized. Anesthesia was induced with isoflurane delivered by facemask until a surgical plane was reached and
an overdose of barbiturate (Euthansol; Merck Animal Health, Kirkland, Quebec) was administered by the intracardiac route.

At necropsy, the animal was in good body condition. Grossly, significant lesions were limited to the right tympanic bulla, which was distorted and enlarged to twice the size of the left bulla (Figure 2). On cut section, it contained a firm white to tan mass, approximately 2 cm in diameter, with a granular translucent appearance and a gritty texture. The mass was moderately well-demarcated and compressed the adjacent temporal bone and cochlea.

Samples from all organs/tissues, including both tympanic bullae, were fixed in 10% neutral-buffered formalin; tympanic bullae were decalcified in hydrochloric acid at 37°C for 12 h. Samples were then processed, embedded in paraffin, cut at 5 μm, and stained with hematoxylin, eosin, phloxine, and saffron (HEPS). Histopathologic examination of the right tympanic bullae revealed a proliferation of spindle-shaped to polyhedral cells arranged in bundles. Multifocally, neoplastic cells produced an amorphous pale pink to yellowish matrix (osteoid) (Figure 3A) with formation of immature bone trabeculae (Figure 3B) and mineralization. In some areas, neoplastic cells had poorly defined borders and moderate amounts of eosinophilic cytoplasm. Pleomorphism was moderate with presence of a few binucleated cells. Mitotic count was low with up to 1 mitosis in 10 HPF. The mass was diagnosed as an osteosarcoma based on the production of osteoid by neoplastic cells. It was classified as chondroblastic since the production of cartilaginous matrix was a prominent feature of the neoplasm (9). On histopathological analysis no other abnormality was detected in any organ, including the lungs.

**Discussion**

Data on tumors in guinea pigs are increasing in the literature. Trichofolliculomas are the most common tumors of guinea pigs (10). There are many reports of reproductive tract tumors in the guinea pig, such as leiomyomas and leiomyosarcomas of the uterus, and ovarian adenocarcinomas and adenocarcinomas of the mammary glands (10). Although digestive neoplasms are not common, a few cases have been reported, such as a case of gastric leiomyoma (11) and a case of gastrointestinal stromal tumor (GIST) (12). Tumors of the urinary system are also uncommon, but transitional cell carcinoma of the bladder, renal adenocarcinoma, and renal fibrosarcoma have been described (10). Several other case reports of tumors in guinea pigs have been published, such as a case of thyroid carcinoma (13) among others (14).

Although few studies on the prevalence of tumors in guinea pigs have been reported, a recent study (15) described spontaneous tumors in guinea pigs. Of the 20 neoplasias examined, 5 were skin tumors (trichofolliculomas, trichoepitheliomas, malignant pilomatricoma), 5 were tumors of the mammary glands (adenocarcinoma and adenoma), 6 were subcutaneous tumors (lipomas, liposarcoma, ossifying fibroma), 3 were lymphatic leukemias, and 1 was hepatocellular adenoma. No osteosarcomas were observed in this study and guinea pigs' age ranged from 2 to 7 y (15).

The guinea pig herein had significant abdominal discomfort upon presentation. Abdominal discomfort often results in non-specific signs such as depression, gastrointestinal stasis, anorexia, and secondary weight loss. However, despite efforts to eliminate each cause of pain in this individual with the management of urinary and ovarian disorders diagnosed initially, the persistent weight loss in a 3-year-old individual warranted further investigation. Differential diagnoses for chronic weight loss in a guinea pig include dental diseases, endoparasites, ovarian cysts, renal diseases, neoplasms, and hyperthyroidism (16). Hyperthyroidism is most often reported in guinea pigs 3 y old and older, and generally secondary to thyroid tumors including
adenoma and adenocarcinoma. Clinical signs of hyperthyroidism are variable, the most frequent being weight loss despite a normal to increased appetite and hyperactivity. However, low concentrations of thyroxine hormone excluded hyperthyroidism in the guinea pig presented here.

Results of the CT imaging revealed a mineralized mass extending from the tympanic bulla to the caudal aspect of the nasopharynx. The location of this mass caused displacement of the airway and proximal esophagus, which may have contributed to difficulty in swallowing although dysphagia was not observed.

Diseases of the middle and inner ear are common and well-described in rabbits (17); however, they are probably under-diagnosed in guinea pigs. Unlike bacterial otitis, ear neoplasias are uncommon in rodents. Fibropapillomas of the ear canal are occasionally found and aural polyps may occur in the tympanic bullae of guinea pigs (10). Diseases of the ear are often associated with clinical signs including head tilt, ataxia, circling, torticollis, and facial nerve paralysis with possible secondary ulcerative keratitis (10). In the present report, the guinea pig’s right eye exhibited enophthalmos and a corneal ulcer. Considering initial ophthalmologic examination, the enophthalmos may have been associated with radiating pain from the neoplastic process, which responded partially to analgesic therapy until an ulcer developed. The corneal lesions may have occurred secondary to lack of lubrication or trauma peri-ovariectomy or possibly secondary to facial nerve paresis although eyelid closure was complete when evaluated. No signs of vestibular disease were observed. Although poorly documented in the guinea pig literature, surgeries of the external, middle, and inner ear are well-described in rabbits (17). Total ear canal ablation and lateral bulla ostectomy would not have allowed a complete surgical resection of this mass.

To the authors’ knowledge, this is the first report describing a chondroblastic osteosarcoma of the middle ear in a guinea pig (18). Osteosarcomas are aggressive malignant bone tumors, with rapid local invasion and high potential for lung metastasis (19). Osteosarcomas have been well-described in humans (20,21), horses (22), dogs (19,23–26), and cats (27), and represent the most common type of bone tumors in dogs (19). In dogs, osteosarcomas most commonly develop in the appendicular skeleton (19,26), with a predilection for specific sites such as distal radius, proximal humerus, distal femur, and proximal tibia (24,26), but tumors of the axial skeleton are not

Figure 3. A – Neoplastic cells surrounded by pink amorphous matrix (osteoid) (asterisks). B – Bundles of spindle-shaped neoplastic cells forming irregular and immature bone trabeculae (arrow), surrounded by osteoid matrix (asterisks). C – Polyhedral to spindle-shaped neoplastic cells produced both osteoid matrix (asterisk), and aggregates of cartilaginous matrix (arrow). D – Aggregates of cartilaginous matrix (arrow) stain bright red with Safranine-O-Fast green staining.
uncommon, including spine, ribs, skull, cranial, oral, and maxillofacial osteosarcomas (24,26). Case reports of appendicular osteosarcoma have also been published in small mammals: osteosarcoma of the left proximal tibia (28) and of the femur (29) in guinea pigs, and osteosarcoma of the right forelimb in a rabbit (30). Considering that, to the authors’ knowledge, only 2 cases of osteosarcomas have been reported in guinea pigs, osteosarcomas are rarely described in this species. In humans and dogs, oral and maxillofacial osteosarcomas seem to be less aggressive than appendicular osteosarcomas, with slower progression and lower trend to metastasis, although locally aggressive (24). Clinical signs may be insidious (26). The guinea pig of this report showed non-specific signs of pain (dysorexia) and ocular signs related to the location of the mass. No pulmonary metastasis was detected on CT examination and on histology for this individual, although lung metastases have been described in this species (29). The chronic weight loss of this individual could be of 2 origins: a mechanical origin by extension of the mass to the pharynx, which impaired swallowing; and a catabolic origin by tumoral mediators (31). Since the individual was still able to eat, cancer cachexia is the more likely.

Presumptive diagnosis of osteosarcoma is based on clinical signs, imaging studies, and cytological evaluation (19,24), although the gold standard for definitive diagnosis remains histological evaluation (24,26). The recommended treatment of osteosarcomas in dogs includes free-margin surgical resection, radiotherapy, and chemotherapy (19,24,32). Given the local aggressive nature of osteosarcomas, 2 to 3 cm tumor-free surgical margins are recommended (33). While amputation is feasible in the cases of appendicular osteosarcomas, free-margin surgical resection may be more complicated in cases of axial osteosarcomas. Local recurrence is not uncommon in dogs and humans with axial osteosarcoma (24). Prognosis depends on the tumor location, presence of metastasis, surgical margins, clinical signs, and body weight of the patient. Tumor-free surgical margins are reported to be the most important prognostic factor in dogs and humans with maxillofacial osteosarcoma (24).

The present report describes the diagnosis of a chondroblastic osteosarcoma of the right middle ear in a guinea pig. Although no metastasis was present, prognosis was guarded due to the location of the tumor and the inability to perform margin-free surgical resection.

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References
Cerebral toxoplasmosis in a cat with feline leukemia and feline infectious peritonitis viral infections

Luca Zandonà, Romina Brunetta, Claudia Zanardello, Marta Vascellari, Luca Persico, Elena Mazzolini

Abstract — A diarrheic young cat died after neurological involvement. Biochemistry pointed to feline infectious peritonitis (FIP). The final diagnosis was severe multifocal meningoencephalitis due to Toxoplasma gondii. The presence of the parasite in the brain was confirmed using immunohistochemical staining. Concomitant feline leukemia virus (FeLV) and FIP were possible contributors to the clinical, fatal outcome.

Résumé — Toxoplasmose cérébrale chez un chat atteint des infections virales de leucémie féline et de péritonite infectieuse féline. Un jeune chat diarrhéique est mort après des symptômes neurologiques. La biochimie a signalé une péritonite infectieuse féline (FIP). Le diagnostic final a été une méningo-encéphalite multifocale grave causée par Toxoplasma gondii. La présence du parasite dans le cerveau a été confirmée à l’aide de la coloration immunohistochimique. La présence concomitante du virus de la leucémie féline (FeLV) et de la FIP sont des facteurs possibles ayant contribué au résultat clinique mortel.

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Cats are definitive hosts in the life cycle of Toxoplasma gondii (1) and can shed the parasite in the environment. Chronic, apparently subclinical infection is common in cats; for example, seroepidemiological studies in Finland and the Netherlands suggest widespread infection in feline populations (2,3) with 3% proportional mortality rate (2,4). Prevention of T. gondii infection is a public health priority (5–7). Although direct contact with cats is not thought to be a risk factor for humans to acquire toxoplasmosis (5), preventing feline T. gondii infection is important to reduce the overall contamination of the environment with oocysts (7–9). Reports of clinical feline toxoplasmosis (1,9) highlight that diagnosing clinical toxoplasmosis in cats can be challenging and the disease is confirmed when the parasite is demonstrated in body fluids or tissues. A tentative diagnosis can be based on rising IgM titers, after excluding other causes for the clinical signs and a positive clinical response to anti-T. gondii drugs (1,9). The case reported here is of interest, as limited information is available on the clinical signs of feline toxoplasmosis.

Case description

In January 2017, a 6-month-old female cat, born in a feline colony but later adopted, was taken to a veterinary hospital because of sudden watery diarrhea. Clinical examination showed poor body development, monolateral cataract, and dehydration. The ophthalmologist suggested that the cataract was of nutritional origin. The body temperature was within the normal range. The cat was initially treated with dietary modification consisting of commercial food for gastrointestinal disorders and antibiotic for presumed bacterial diarrhea (spiramycin-metronidazole, Stomorgyl; Merial Italia, Milan, Italy), 10 mg/kg body weight (BW), PO, q12h for 10 d. Fluid replacement therapy was not provided. Fecal examination with a flotation method at 100× magnification for parasite eggs and oocysts was negative. A commercially available enzyme-linked immunosorbent assay (ELISA) test for Giardia spp. (SNAP Giardia; IDEXX Laboratories, Westbrook, Maine, USA) was negative. There was no clinical response to the dietary modification and antimicrobial therapy.

Fifteen days after the onset of diarrhea the patient displayed neurological signs such as body tremors and nystagmus. A blood sample was collected for a hemogram and serum biochemical tests to investigate the causes of the neurological signs. Treatment with clindamycin (Antirobe; Zoetis Italia, Rome, Italy), 10 mg/kg BW, PO, q12h, was initiated after tentative diagnosis of neurological toxoplasmosis or septicaemia with brain involvement. The following day the cat was blind, and had head tremors and convulsion. The cat died on the 17th day after presentation.

The laboratory report was available after the cat died. The hemogram detected leukocytosis [12.09 × 10^9/L; reference...
range (RR): 5.0 to 11.0 × 10⁹/L with neutrophilia and monocytosis. Erythrocyte count was within the reference range (red blood cell count 6.76 × 10¹²/L; RR: 6.35 to 9.0 × 10¹²/L); estimated platelet concentration was adequate. Biochemical blood tests showed evidence of systemic inflammation (serum amyloid, 122.5 mg/L; RR: 0.1 to 0.5 mg/L), hyper-bilirubinemia (11.9 µmol/L; RR: 2.4 to 4.4 µmol/L) with liver enzymes within the reference range, decrease in serum cholinesterase (848 IU/L; RR: 1955 to 3950 IU/L), decrease in serum creatinine (37.1 µmol/L; RR: 84.0 to 163.5 µmol/L), and hyponatremia (133 mmol/L; RR: 145 to 152 mmol/L). The serum protein concentration was 78 g/L (RR: 63 to 78 g/L) with hypoalbuminemia (18 g/L; RR: 30 to 40 g/L), and hyperglobulinemia (62 g/L; RR: 30 to 45 g/L). Serum protein electrophoresis showed polyclonal hyperglobulinemia and an increase in the alpha-2 globulin component. Serological and biomolecular screening for viruses causing infection in cats and for anti-Toxoplasma gondii antibodies (IgG-IgM) was not performed.

At necropsy examination, the patient was in poor body condition, with opacity of the lens due to monolateral cataract. The gut was affected by catarrhal enteritis with edematous mucosa and pale intestinal wall. The liver appeared mottled with multiple tiny white circular lesions disseminated throughout the entire parenchymal tissue. The kidneys had multifocal white circular lesions of various sizes. The frontal sinus was full of green exudate. The brain had edema of the cerebral cortex.

The kidney, liver, spinal cord, and brain were fixed in formalin and routinely processed for histological examination. The kidney showed chronic severe multifocal pyogranulomatous nephritis (Figure 1a) with multifocal tubular necrosis and mineralization. The liver showed multifocal moderate chronic hepatitis with perivascular lymphoplasmacellular infiltration and multifocal biliary stasis. The spinal cord and brain samples showed severe multifocal necrosis associated with severe lymphoplasmacytic infiltration and numerous macrophages, lymphoplasmacellular perivascular cuffing and vasculitis. Many hyperesinophilic oval protozoan cysts having a thin wall and containing basophilic bradyzoites were seen near to vascular structures (Figure 1b). The meninges were moderately infiltrated by lymphocytes, plasma cells, and macrophages.

Immunohistochemistry (IHC) was done on 3-µm sections of the liver, kidney and brain which were all stained with antibodies against feline coronavirus (FIPV3-70 clone; BIO-RAD Segrate, Milan, Italy) and T. gondii (210-70-TOXO, VMRD, Segrate, Milan, Italy).
Discussion
The cat plays a central role in the lifecycle of *T. gondii* and prevention of feline infection is a measure for reducing the overall oocyst shedding in the environment (5–9). The case we report here is of interest because a neurological FIP was strongly suggested by the clinical signs and biochemical tests. Although it is usually included in differential diagnoses of neurologic diseases in cats, clinically manifested toxoplasmosis, especially with neurological clinical signs, is uncommon or underdiagnosed. In this case we linked the neurological clinical signs to toxoplasmosis only after the parasite was detected in the brain. The parasite was not detected in the liver, in contrast to the observations in other cases of fatal toxoplasmosis in cats (1,2). Furthermore, coronavirus viral particles were found only in the kidney and not in the brain. It is reported that an immunosuppressed cat may develop systemic toxoplasmosis with extraintestinal spread of tachyzoites following initial exposure or reactivation of tissue cysts (1). However, clinical and fatal toxoplasmosis, including toxoplasmosis with cerebral involvement, has been described in apparently immunocompetent cats (2,10). In the case we describe here FeLV and FIP co-infection may have facilitated the neurologic outcome of toxoplasmosis.

The brain is a common site of replication and chronic persistence of *T. gondii* infection. Neurological or ocular involvement, in the absence of other clinical signs, are perhaps more common after reactivated toxoplasmosis (1). Ocular localization of *T. gondii* appears common in cats infected during gestation (11). Regrettably in our case the eye lesions were not examined histologically.

Few reports in the literature describe clinically manifested cerebral toxoplasmosis. A Finnish study describes 6 clinical cases of cats that died because of generalized toxoplasmosis. All patients had a history of acute illness lasting approximatively 1 wk with nonspecific clinical signs (apathy, inappetence, dehydration, fever). None of the patients had received immunosuppressive drugs, but the presence of other immunosuppressive factors remained unclear. Incoordination was the only neurological sign observed in 3 of the 6 cats. Gross pathological lesions were not seen in the brain but 5 cats had histological brain lesions (glial granuloma) associated with *T. gondii* detected by IHC investigation (2). In an Austrian study on feline meningoencephalitis, cerebral toxoplasmosis was described in 14 of 89 samples, protozoan cysts were identified in the histological sections of the brain, and *T. gondii* infection was confirmed by immunohistochemistry (12). In both studies IHC was the confirmatory test after detection of histological lesions. In the Finnish study, the parasite strains were isolated in cell culture and genotyped from brain samples of 2 cats.

Fatal systemic toxoplasmosis was described in an apparently immunocompetent cat in Switzerland (10). Necrotic lesions were described in lung, liver, and lymph nodes; multiple and small foci of gliosis were present in the brain and protozoan cysts were occasionally observed in these foci (10). Diagnosis was confirmed by specific real-time polymerase chain reaction (RT-PCR) on fresh sample of intestine, lung, liver, spleen, bone marrow, and mesenteric lymph nodes (10).

Co-infection of FeLV and FIP occurs rarely (13) and we believe the immune imbalance due to virus co-infection may have facilitated the occurrence of clinically manifested fatal toxoplasmosis. This case underlines that toxoplasmosis in cats should always to be taken into account in differential diagnosis when neurological signs are displayed.

Acknowledgment
We thank Dr. Fabrizio Agnoletti for excellent logistical and technical support.

References
Hepatic *Dicrocoelium dendriticum* infection in a miniature horse

Murray Hazlett, Margaret Stalker, Mary Lake, Andrew Peregrine

**Abstract** — A miniature horse which died following humane seizure from an Ontario farm was emaciated with serous atrophy of fat. Autopsy revealed hepatic atrophy and moderate periportal fibrosis. Eggs and trematodes seen in the liver were identified as *Dicrocoelium dendriticum*. This appears to be the first reported case of infection of equids in North America with *Dicrocoelium dendriticum*.

**Résumé** — Infection par *Dicrocoelium dendriticum* hépatique chez un cheval miniature. Un cheval miniature qui est mort à la suite d’une saisie humanitaire dans une ferme de l’Ontario était émacié et avait une atrophie séreuse des tissus adipeux. L’autopsie a révélé une atrophie hépatique et une fibrose périportale modérée. Des œufs et des trématodes observés dans le foie ont été identifiés comme *Dicrocoelium dendriticum*. Il semblerait qu’il s’agit du premier cas signalé d’infection des équidés par *Dicrocoelium dendriticum* en Amérique du Nord.

*Dicrocoelium dendriticum*, also known as the small liver fluke or lancet liver fluke, is a small liver fluke which typically infects ruminants. The fluke is a parasite of the gall bladder and bile ducts and is able to reproduce by both cross insemination and hermaphroditism. It has a complex life cycle involving 2 intermediate hosts — terrestrial snails and ants. Infecting terrestrial snails first, the eggs hatch into sporocysts, develop, and then become cercariae. The cercariae are shed from the snail in mucoid “slime balls” which are ingested by ants. This first stage takes 3 to 4 mo. Over the next 1 to 2 mo in ants they develop into metacercariae and sometimes localize in the ant’s nervous system. Temperatures less than 15°C cause the ant to cramp, keeping them on the tips of grass and predisposed to being eaten by grazing animals. In ruminants, the metacercariae excyst in the small intestine, then migrate into the bile ducts and gall bladder. Eggs are released in feces about 2 mo after infection, with its full life cycle taking about 6 mo (1).

The known geographic distribution of *D. dendriticum* is primarily Europe and Asia, with sporadic occurrence in North America (2). It is not regarded as native to North America, but has an invasion history, first anecdotally noted in Eastern Canada in the 1930s, where it was likely introduced from Europe, explaining why it is still relatively rare in Canada (3). In Ontario, infections are occasionally diagnosed in pastured sheep and cattle in southern parts of the province, with liver lesions observed at slaughter (4).

*Dicrocoelium dendriticum* can occasionally infect other animals, including pigs, dogs, rabbits, horses, and humans (1). Scientific publications regarding infection in horses and donkeys are primarily limited to brief mention in textbooks and review articles. However, there are references to infection of equids in Denmark (5), Nigeria (6), Switzerland (7), and Turkey (8,9).

The authors have been unable to find any case reports in equids in North America.

This report describes the occurrence of *D. dendriticum* in a young miniature horse.

**Case description**

In the winter of 2017, the Ontario Humane Society investigated a small farm in southern Ontario following reports of neglect of care of resident animals. The animals on the farm included a miniature horse, 17 chickens, 3 goats, and 6 rabbits. The horse and 1 of the goats were subsequently submitted to the Animal Health Laboratory (AHL) at the University of Guelph for necropsy examination to document the condition of the animals and cause of death. The submitted goat was found dead; the submitted horse died several hours after seizure. The horse had been on the farm for 48 h, but its origin before this could not be determined. The horse and goat were frozen at the time of submission.

Both animals were emaciated and had serous atrophy of fat. The horse was a neutered male with 4 fully erupted and worn upper incisors, and no eruption of the lateral 2. Based on this dentition the horse was estimated to be about 4 y old. It had a body weight of 36 kg. The liver appeared small and weighed 500 g (1.4% of body weight).

Using the Cornell-Wisconsin Centrifugal Flotation technique on feces from the horse, low numbers of strongyle and *Oxyuris equi* eggs were observed. Extrapolating from a study using...
bovine feces and *Haemonchus contortus*, this would translate to between 1 and 30 eggs per gram (epg) of feces for each. Analytic sensitivity was reported to be 1 egg per 5 g of feces (10). Sensitivity using strongyle and *O. equi* eggs, or for trematodes has not been determined.

Routine histology with preparation of hematoxylin and eosin (H&E)-stained slides was performed on major organs. Microscopically, tissues from the horse displayed marked autolysis and freeze artifact. There was skeletal muscle atrophy and mild interstitial mononuclear nephritis, the latter being regarded as incidental. In the initial liver section a cross section of a small trematode containing eggs was seen (Figure 1A). The liver was re-examined grossly, and additional sections were collected for histology from different parts of the liver. In 1 of the 10 histology sections, an additional single trematode containing eggs was seen (Figure 1B) as well as a bile duct containing trematode eggs. In all 11 liver sections there was moderate periportal fibrosis (Figure 1C). Additionally, careful gross microdissection down the bile ducts recovered a single small trematode that was identified based on its morphology and the egg characteristics as

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**Figure 1.** A – *Dicrocoelium dendriticum* cross section in remnants of a bile duct. Eggs can be seen in the uterus of the trematode (arrows). Hematoxylin and eosin (H&E) stain. B – more longitudinal orientation of a partial *D. dendriticum* in a bile duct. The oral sucker is visible (arrow). H&E stain. C – periportal fibrosis (arrows) including necrotic cellular debris in a larger duct (large arrow). H&E stain. D – eggs of *D. dendriticum* released from the dissected frozen, unfixed, liver tissue. Wet mount. E – autolyzed body of recovered intact *D. dendriticum*. Wet mount.
D. dendriticum (Figures 1D and 1E). The dissected trematode was autolysed and ~5 mm in length [normal in sheep: 4.70 to 5.60 mm in length (2)]. Eggs (n = 10) measured ~35.6 μm (range: 30.2 to 43.6 μm) × 21.8 μm (range: 18.9 to 23.7 μm) with a brown shell and were operculate (Figure 1D), consistent with D. dendriticum (2).

A computer search of Province of Ontario and University of Guelph animal pathology records from May 1988 to December of 2017 found no other cases of trematodes in horses.

Discussion
The most common liver fluke reported in horses globally is Fasciola hepatica. Although infection is considered rare in horses, it is somewhat more common in donkeys (11). Equine D. dendriticum infection is likely very rare in Ontario, this being the first case seen at the AHL. Even in endemic areas, because horses are not a primary host and are not usually pastured with ruminants, infection would be expected to be rare. The infection is occasionally mentioned in textbooks and review articles, in which a primary reference is not cited. Documented cases of equine infection seem confined to Europe, some areas of Asia, and Africa (5–9). Unlike F. hepatica, D. dendriticum infection is likely very rare in Ontario, this being perhaps incidental to the emaciation and death, which was assumed to be due to malnutrition, as no other contributing causes were found on autopsy examination.

This report represents the first time D. dendriticum infection has been documented in a horse in North America.

References
Progressive ossifying paranasal sinus mass of suspected traumatic origin in a mare: Surgical treatment and follow-up

Eva Haltmayer, Hubert Simhofer

Abstract — This report describes a case of a multilobular, osseous mass including parts of the right orbit, concho frontal sinus and right ventral and dorsal conchal sinuses that developed after a traumatic insult to the right maxillary sinus 4 years prior to presentation. Surgical removal of the mass including parts of the bony orbit and long-term outcome are reported.

Résumé — Masse des sinus paranasaux à ossification progressive d’origine traumatique soupçonnée chez une jument : traitement chirurgical et suivi. Ce rapport décrit une masse multilobulaire et osseuse comprenant des parties de l’orbite droite, des cornets nasaux frontaux et des sinus ventral et dorsal droits qui s’est développée après un traumatisme du sinus maxillaire droit 4 années avant la présentation. L’ablation chirurgicale de la masse, incluant des parties de l’orbite osseuse et les résultats à long terme sont signalés.

Benign fibro-osseous tumors such as osteoma, ossifying fibroma, or fibrous dysplasia are uncommon in domestic animals, but seem to occur more frequently in cattle and horses (1). All of these tumors show various stages of osteogenic differentiation and ossification and are therefore suspected to originate from the same basic pathology and eventually form osteomas (1–4). In contrast, fibrous dysplasia is not defined as a true bony neoplasia, as it consists of a cellular fibro-vascular stroma with thin, poorly mineralized osteoid or bone spicules (2). Only a limited number of case reports and case series have been published describing treatment and outcome in horses with bone-associated tumors of the paranasal sinuses. In a previous published report of 256 cases with sinonasal disorders, 22 cases were diagnosed with neoplasia (5). Amongst these, only 1 was an osteoma and a fibroma (5). Dixon and Head (3) described 5 cases with neoplasia originating from bony sinus structures. Osteomas are usually suitable for surgical removal due to their small pedunculated attachment; however, the complex anatomy of the equine paranasal sinus makes complete removal without massive injury to adjacent structures challenging (6), especially if the bony portion of the orbital floor is involved. So far only 2 reports describe multilobular sinus tumors in horses (7,8). To the authors’ knowledge the current case is the first report that suggests an association between a traumatic insult to the sinus system and the subsequent development of an osseous sinus mass.

We describe diagnosis and treatment of a multilobular ossified mass extending from the right orbit to the right concho frontal, dorsal and ventral, conchal sinus of suspected traumatic origin.

Case description

A 6-year-old, 548-kg Swedish warmblood mare was admitted to the reporting clinic because of a progressive, right-sided facial swelling and right serous ocular discharge. At 1.5 y old, the mare had sustained a perforating injury by a tree branch in the area of the right concho frontal and caudal maxillary sinus. The wound had been treated but subsequently a bony swelling rostroventral to the right eye developed and the patient started to show right-sided ocular discharge. At the age of 4 y an osseous mass was partly removed from the right caudal maxillary sinus in a standing procedure at an equine clinic. According to the surgical report approximately 40% of the mass was removed during this surgery. Histopathological examination of the resected mass revealed dense osseous tissue with trabeculae of mineralized lamellar bone and a normal amount of osteocytes. Due to the histologic appearance and extreme density of tissue specimens submitted, a presumptive diagnosis of an osteoma was made.

Progressive regrowth of the mass within 1 y after the surgical intervention resulted in a right-sided facial swelling rostroventral to the right eye and unilateral serous ocular discharge. On initial examination at the reporting clinic, the horse was in good body condition and vital parameters were within

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normal limits. Abnormal findings included a 5-cm long, 6-cm wide, and 2-cm thick bony convexity in the area of the right caudal maxillary sinus and concho frontal sinus rostroventral to the right eye and mild, right-sided serous ocular discharge (Figure 1). A computed tomography (CT) examination performed before admission revealed a mass with bone attenuation (~1000 Houndsfield units) originating from the right orbit and zygomatic arch occupying approximately 2/3 of the right concho frontal sinus, extending into the right ventral and dorsal conchal sinuses. Osteolytic changes and thinning of bony lining was observed at the entire bony orbital floor as well as in the part of the maxillary bone that covered the osseous mass (Figure 2).

Surgical removal of the osseous mass was recommended. The horse was anesthetized and placed in left lateral recumbency. A right maxillary nerve block was performed during general anesthesia under aseptic conditions with 10 mL of mepivacaine (Mepinaest; Gebro Pharma GmbH, Fieberbrunn, Austria) (9) and 10 mL of ropivacaine (Naropin; AstraZeneca Gmbh, Vienna, Austria) using the extraperiorbital fat body insertion (EPFBI) technique. A modified right maxillary bone flap was created with the skin incision starting 1 cm rostral and 1 cm ventral to the medial canthus of the right eye, extending in a caudoventral direction towards the zygomatic arch. The skin incision was extended for 10 cm in a rostral direction about 1 cm dorsal to the zygomatic arch and facial crest (Figure 3). One centimeter caudal to the rostral end of the facial crest, the incision was directed in a dorsal direction for 7 cm. Subcutaneous tissue and periosteum were incised in the same plane and 3 mm of periosteum were elevated on either side of the incision using a sharp periosteal elevator. The exposed maxillary bone was cut with an oscillating saw in bevelled fashion and the bone flap was subsequently elevated with a pair of chisels and fractured along its dorsal aspect as previously described (10). While the rostral half of the maxillary bone flap appeared slightly irregular and thickened, the caudal half was extremely thin.

Elevation of the bone flap exposed a fraction of the bony mass emanating from the right orbit and zygomatic arch. The exposed surface of the mass appeared smooth and harder than normal bone (Figure 3). The mass was gradually reduced by chipping off fragments of varying sizes with straight and curved chisels and a mallet. In the caudal direction the mass merged into the orbital process and the temporal process of the zygomatic bone. The periorbital fascia was dissected bluntly from the orbital process of the zygomatic bone and elevated with blunt tissue retractors to facilitate further removal of the pathological bony overgrowth. Following removal of most of the bony floor of the orbit, more pathologically changed bone extending into the temporal process of the zygomatic bone was removed. In order to avoid transection or fracture of the zygomatic arch and subsequent instability, a small portion of sclerotic bone was left in place. Finally, the peg-shaped rostral portion of the mass extending into the ventral and dorsal conchal sinuses was removed with intraoperative radiographic control. This portion was well-delineated and had no contact with other facial bones. Further radiographs confirmed complete removal of the rostral portion of the mass.

All visible bone fragments were removed and the sinuses were subsequently flushed with sterile Ringer’s solution. Intraoperative inspection of the periorbital tissues after resection of the mass revealed an 8-mm fascial rent and a small prolapse of retro-bulbar fat. A Board-certified ophthalmologist was consulted immediately to evaluate the right eye. Based on his recommendations and the fact that the right globe appeared only minimally sunken we decided to preserve the right eye. The frontal trephination portal from the first surgery was reopened to gain access to the concho frontal sinus.

The right ventral conchal sinus was perforated into the nasal cavity using long-handled (35 cm), bent dressing forceps. An elastic net bandage with iodine-impregnated gauze was passed through the opening into the nasal passage exiting at the right

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**Figure 1.** Bone dense right-sided facial swelling rostroventral to the right eye.

**Figure 2.** Pre-surgical CT images showing the most rostral (A) and caudal (D) extension of the bone dense mass. B and C — Note the osteolytic changes and thinning of bony lining at the entire bony orbital floor as well as in the right maxillary bone covering the osseous mass (white arrows).
nostril using a flexible urinary catheter. The packing material was sutured to the nostril. Additional gauze packing was inserted into the concho frontal sinus through the frontal trephination portal.

The thin caudal half of the bone flap was resected because it had fractured along the junction with the thicker part and the remaining bony portion together with the skin and subcutaneous tissues of the flap were repositioned. Closure was completed in 3 layers (periosteum, subcutaneous tissue, skin). Total surgery time was 300 min and total estimated blood loss was 3 to 4 L.

Before and after surgery and continuing for 7 d post-surgery the horse received penicillin (Penicillin G Natrium; SANDOZ GmbH, Kundl, Austria), 30 000 IU/kg body weight (BW), IV, q6h, gentamicin (Gentavan; VANA GmbH, Vienna, Austria), 6.6 mg/kg BW, IV, q24h, flunixin meglumine (Finadyne; MSD Animal Health, Walton, Milton Keynes, Buckinghamshire, UK), 1.1 mg/kg BW, IV, q12h, and omeprazole (GastroGard; Merial GmbH, Hallbergmoos, Germany), 4 mg/kg BW, PO, q24h. Additional analgesia was provided by administering morphine hydrochloride (Vendal; G.L. Pharma GmbH, Lannach, Austria), 1 mg/kg BW, IV, q6h for 2 d. Subsequently, meloxicam (Metacam; Boehringer Ingelheim Vetmedica GmbH, Ingelheim, Germany), 0.6 mg/kg BW, PO, q24h and omeprazole (GastroGard; Merial GmbH), 4 mg/kg BW, PO, q24h were administered for 3 d.

The horse developed no major complications after surgery, only a mild left-sided facial nerve paralysis and a very mild left-sided triceps myopathy; both were attributed to the left lateral recumbency during surgery and resolved within 12 h after surgery.

The sinus packing was removed 3 d after surgery. Control radiographs on the fifth day after surgery indicated that no remnants of the mineralized mass remained in the right paranasal sinuses. For the next 4 wk, endoscopic examinations and lavages of the paranasal sinuses with sterile Ringer’s solution were performed under sedation at 3- to 4-day intervals. Endoscopic examinations revealed progressive, uncompromised wound healing. Multiple small bony fragments were identified during endoscopy and removed with endoscopic forceps.

The right globe showed a slight enophthalmos but no loss of vision could be detected during hospitalization. Histopathological examination of the resected mass revealed mature reactive fibrous tissue without any evidence of neoplasia or inflammation. Small isolated areas of mature bone within the fibrous tissue were detected. The histological findings were interpreted as being consistent with a chronic lesion and very likely the result of a former trauma to the area.
Nineteen days after surgery a second CT examination was performed under general anesthesia. Two small bony fragments were identified in the caudal maxillary sinus near the roots of the last molar. Another small bony fragment was located close to the trephination site of the frontal bone. The maxillary bone showed marked thickening of the caudal part of the bone flap. The area of the temporal process of the zygomatic bone, where a remnant of the mass was left in place, appeared sclerotic (Figure 4). The fragments were subsequently removed under endoscopic control and the horse was discharged 50 d after surgery.

Follow-up telephone calls to the owner were made over a 2-year period. The horse had an episode of facial swelling 3 mo after surgery that was treated with oral antibiotics by the referring veterinarian. The swelling subsided after a few days of treatment and did not recur when antimicrobials were discontinued. No other complications or signs of regrowth were reported by the owner. At the time of writing, 2 y and 3 mo after removal of the mass, no clinical signs were reported by the owner and the horse was successfully performing at her previous level of performance. The owner also reported satisfaction with the overall cosmetic outcome.

Discussion

Histopathological findings of the paranasal sinus mass found in the case described herein revealed the mass to be composed predominantly of chronic fibrous tissue infiltrated with areas of bone. This histological appearance was more consistent with an ossifying fibroma than a typical osteoma. Histologically benign fibro-osseous masses are composed of fibrous tissue, cells, and mineralized cancellous and compact bone in various proportions (1). In contrast, osteomas form well-differentiated areas of bone within a fibrous stroma. Even areas of well-developed Haversian systems may be found. Chronic ossifying fibromas possess features of both osteomas and fibrous dysplasia. Well-differentiated osteoids within a fibrous stroma can be detected next to poorly mineralized bone spicules (2). In the current case, however, gross pathology, and radiographic and CT findings were indicative of an osteoma. Histopathological examination revealed chronic fibrous tissue around the areas of well-differentiated mature bone, features that would be consistent with an ossifying fibroma. However, no signs of malignant growth or metastatic activity could be found in the excised tissue. Therefore, considering all results, the presumptive diagnosis of an osteoma was made. Osteomas are characterized by a smooth surface, lobulated shape, and an expansive, noninvasive growth pattern. They consist of bone with abnormal density but normal architecture (3).

Osteomas are expansive and are typically found in the maxillary sinus in horses (3,6). This feature was expressed as swelling and deformation of the facial bones in the case reported. Although osteomas are usually amenable to surgical removal, the complex anatomy of the equine sinus system may impede complete resection (6). Regrowth after surgical excision was not associated with incomplete resection (11). The overall outcome after surgical resection of sinus osteomas is reported to be good with no signs of recurrence in 3 of 5 cases between 18 mo and 10 y after surgery (12–14). In contrast, ossifying fibromas seem to have a more guarded prognosis compared with osteomas since all reported cases showed signs of regrowth (15,16). In the case described in this study the osteoma was found in the right concho frontal sinus, extending into the right ventral and dorsal conchal sinuses as well as the right orbital floor. The bony orbital floor had undergone pressure resorption and thinning and was subsequently removed.

Complications after fractures of the orbit in which the integrity and supportive function of the bony part of the orbital floor are disrupted, as in our case, include traumatic uveitis, lacerations of the globe, herniation of the retro-bulbar fat and globe into the sinus system, changes in position of the globe, and loss of vision (17).

In human medicine various techniques for orbital floor reconstruction after orbital floor fractures or surgical excision after tumor removal are described. Allogenic implants commonly used are made of high-density polypropylene poly-L-lactic acid or polyglycolic acid and titanium (18–20). Another method for reconstruction is the use of autologous bone grafts (19,20). In these studies, the 2 most common clinical signs described after orbital floor fractures and herniation of orbital soft tissues into the sinus system are diplopia and enophthalmos. Diplopia is mainly caused by impaired function of the extra-ocular muscles (21–23). Usually these symptoms can be alleviated by performing orbital floor reconstruction and restoration of support for orbital soft tissues (24). In our case orbital floor reconstruction with any kind of implants was not considered due the fact that the mare had concurrent sinusitis of the right maxillary and concho frontal sinus and therefore was at an increased risk of implant infection. Mild enophthalmos was detected in our case. Whether the horse was suffering from diplopia or other impairments of vision would have been difficult to determine. All ophthalmologic examinations performed after surgery revealed no pathologies and no behavioral changes were observed during hospitalization that would have indicated impairment in vision. In summary, resection of the bony part of the orbital floor might be possible without major impairments in certain cases. However, to the authors’ knowledge, this is the first report to describe this procedure and further documentation of similar cases will be necessary to determine possible complications and drawbacks.

In human medicine osteoma formation after trauma to the facial bones has been documented in a few case reports (25–27). The most common site for osteoma formation was the mandible (26). However post-traumatic osteomas were also associated with the orbit or the maxillary sinus (25,27). The etiopathogenesis of these osteomas is still not completely elucidated, but a reactive neoplastic transformation of the periosteum or bone itself is suspected (25–27). Therefore in the case reported herein, the osteoma most likely developed as a result of trauma (tree branch injury) to the maxillary sinus before presentation.

References


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Musculoskeletal discomfort among Canadian bovine practitioners: Prevalence, impact on work, and perception of physically demanding tasks

Xiaoke Zeng, Robyn Reist, Murray Jelinski, Brenna Bath, Nathan Erickson, Chris Clark, Catherine Trask

Abstract — Musculoskeletal discomfort (MSD) is prevalent in large animal veterinarians but little research has been conducted on prevalence of MSD and its impact among Canadian bovine veterinarians. This 2017 survey targeted practicing and retired members of the Western Canadian Association of Bovine Practitioners, and adapted the Nordic Musculoskeletal Questionnaire to quantify MSD prevalence. Open-ended questions were used to determine the impact of MSD on work and to determine what were perceived to be the most physically demanding tasks. The survey response rate was 51.4% (133/259). Prevalence of MSD was high, with 12-month and lifetime rates of 89.5% and 96.9%, respectively. Obstetrical procedures, rectal examinations, and bull semen collections were reported as the 3 most physically strenuous tasks. The high MSD prevalence rates observed in the shoulder, neck, and lower back call for research on direct ergonomic assessments and work practice interventions for bovine veterinarians.

Résumé — Inconfort musculo-squelettique parmi les praticiens bovins canadiens : prévalence, impact sur le travail et perception des tâches exigeantes sur le plan physique. L’inconfort musculo-squelettique (IMS) est prévalent chez les vétérinaires pour grands animaux mais peu de recherches ont été réalisées sur la prévalence de l’IMS et son impact parmi les vétérinaires bovins canadiens. Cette enquête de 2017 a ciblé les membres praticiens et retraités de la Western Canadian Association of Bovine Practitioners et a adapté le questionnaire nordique sur la santé musculo-squelettique pour quantifier la prévalence de l’IMS. Des questions à réponse libre ont été utilisées pour déterminer l’impact de l’IMS sur le travail et déterminer ce qui était perçu comme les tâches les plus exigeantes physiquement. Le taux de réponse a été de 51,4% (133/259). La prévalence de l’IMS était élevée, avec des taux de 12 mois et d’une vie de 89,5 % et de 96,9 %, respectivement. Les interventions obstétriques, les examens rectaux et le prélèvement de sperme chez les taureaux étaient signalés comme les tâches les plus difficiles sur le plan physique. Des taux élevés de prévalence de l’IMS ont été observés dans les épaules, le cou et le bas du dos et nécessitent de la recherche sur les évaluations ergonomiques directes et des interventions pour les pratiques de travail des vétérinaires bovins.

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Introduction

Being a veterinarian is associated with an elevated risk of developing occupational illnesses. Veterinary practitioners may be exposed to an array of biological, chemical, psychosocial, and ergonomic hazards (1,2), contributing to elevated risks of adverse health conditions such as zoonotic diseases, mental illnesses, and musculoskeletal disorders (MSD) (1–5). Having musculoskeletal symptoms is common in the veterinary workforce; studies have shown that 60% to 90% of veterinarians have experienced musculoskeletal pain or discomfort over the last 12-month period (6–8). By body region, prevalence rates of musculoskeletal discomfort were the highest in the lower back (63%), neck (57% to 66%), and shoulder (54% to 61%) (9,10). This ~60% prevalence rate for neck and shoulder symptoms among veterinarians was also much higher than the ~20% typically observed in mixed occupations (11).

Veterinarians who work with large animals, such as beef and dairy cattle, appeared to have different injury patterns compared to those who work with small or companion animals. Large animal veterinarians experienced more acute animal-related injuries (1). Heavy physical work has been identified as a causal factor for developing MSD (12), which was especially observed at the
neck and upper limb locations among large animal practitioners (10). These practitioners had elevated physical exposures of lifting, awkward posture, and repetitive movement while performing tasks such as rectal palpations or large animal handling (13). For example, ~60% of Finnish equine veterinarians reported working in awkward postures such as bending over or twisting for more than 1 h during the workday; ~30% reported working with arms above shoulder height (2).

Musculoskeletal disorders are the second major contributor to years lived with disability in the general population (14), having a negative impact on work-related activities and overall quality of life. Prior research conducted among New Zealand large animal practitioners found 75% of those who experienced musculoskeletal symptoms had their work activities impeded, which led to work absence in 24% (7).

There are approximately 14,000 veterinarians and 3,500 veterinary practices in Canada, and ~30% of practices work with large animals (15). Bovine practitioners, specializing in the treatment of beef and dairy cattle, play an important role in food animal production. After swine, cattle are the 2nd most common livestock on Canadian farms with over 12 × 10^6 head comprised of bulls, cows, heifers, calves, and steers (16). Procedures in bovine health and breeding practice require heavy physical work. Little research has been conducted on MSD prevalence and its impact on bovine veterinarians. The objectives of this study were to quantify the prevalence of musculoskeletal symptoms among Canadian bovine practitioners, to describe its impact on work, and to describe the most physically demanding tasks as perceived by bovine practitioners.

### Materials and methods

The Western Canadian Association of Bovine Practitioners (WCABP) plays an important role in beef and dairy food production in western Canada, directly supporting bovine practitioners in the area of continuing education. The WCABP represents ~260 veterinarians specializing in dairy and beef practice in western Canada (17). Based on data obtained from WCABP, active and lifetime members are from Alberta (50%); Saskatchewan (29%); British Columbia (11%); Manitoba (8%); and Ontario (2%). This study targeted 259 practicing and retired members of the WCABP; student members were not included.

Prior to recruitment of participants, a keynote presentation on musculoskeletal issues in large animal practice was made at the WCABP’s annual conference in January 2017. In March 2017, detailed study information and a paper survey were sent to WCABP members via the quarterly newsletter. Participation in the survey was voluntary and the results were confidential. Ethics approval was obtained from the University of Saskatchewan’s Biomedical Ethics Board (Bio # 16-291).

The study questionnaire covered personal, health, and work characteristics. Basic demographic information included gender (male/female), dominant hand (right/left/ambidextrous), age (years), height (cm), and weight (kg). The questionnaire also included questions regarding general health and experience of musculoskeletal discomfort, in particular, its impact on work.

Musculoskeletal health questions were adapted from the Nordic Musculoskeletal Questionnaire (NMQ) (18). Body regions included in this adapted questionnaire were: the neck, one or both shoulders, one or both elbows, one or both hands, upper back, lower back, one or both hips/thighs, one or both knees, and one or both ankles. For each body region, participants were asked, “have you at any time in the last 12 months had trouble (ache, pain, discomfort)?”, “have you at any time in the last 12 months been prevented from doing your normal work (at home or away from home) because of the trouble?”, and “have you at any time in the last 12 months been prevented from doing bovine tasks because of the trouble?”. To understand the impact of musculoskeletal discomfort, the following 3 open-ended questions were included: “how have musculoskeletal symptoms impacted your work?”, “have you ever considered leaving bovine practice due to musculoskeletal symptoms?” and “is there anything else you’d like to tell us about your musculoskeletal health or work tasks?”.

Veterinary professional information was collected on numbers of partners in the practice, the year of graduation from veterinary school, and the amount of time apportioned to each practice type (dairy, beef, equine, other large animals, or small animals). Veterinarians were also asked to estimate the total number of rectal examinations completed annually, to estimate the percentage of rectal examinations performed using ultrasound, and to report the 3 self-perceived most physically strenuous work tasks.

To ensure appropriate vocabulary and relevance to practice, a draft survey was piloted among 3 large animal veterinarians from the University of Saskatchewan’s Western College of Veterinary Medicine. Revisions were made to the survey based on feedback.

The survey employed a mixed-mode design method as described by Dillman et al (19). The survey was both mailed (paper copy) and available for online completion. A postage-paid return envelope was included with each mailing. A total of 3 questionnaire mail-outs were sent to WCABP members in mid-March, end of April, and mid-June, 2017. The time between each mail-out was about 6 wk. An e-mail reminder was sent to the WCABP membership at the 2-week time point following each mail-out. Throughout the survey period, the survey was promoted on social media platforms (Facebook and Twitter). Responses were received from March to August 2017.

Descriptive analyses were conducted using SPSS (IBM, Armonk, New York, USA) using medians, quartiles, ranges, and percentages. Distributions of continuous variables were explored graphically and with the Kolmogorov-Smirnov test for normality. Body mass index was calculated using weight (kg) divided

### Table 1. Personal characteristics of participating western Canadian bovine practitioners.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Median (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years old) (N = 131, 100%)</td>
<td>51.0 (28.0 to 84.0)</td>
</tr>
<tr>
<td>Male (n = 94, 71.8%)</td>
<td>53.0 (29.0 to 84.0)</td>
</tr>
<tr>
<td>Female (n = 37, 28.2%)</td>
<td>42.0 (28.0 to 64.0)</td>
</tr>
<tr>
<td>Height (cm) (N = 131)</td>
<td>178.0 (155.0 to 196.0)</td>
</tr>
<tr>
<td>Weight (kg) (N = 131)</td>
<td>83.0 (54.0 to 136.0)</td>
</tr>
<tr>
<td>Body mass index (N = 131, 100%)</td>
<td>25.9 (19.1 to 36.5)</td>
</tr>
<tr>
<td>Normal weight (n = 45, 34.3%)</td>
<td>23.5 (19.1 to 25.0)</td>
</tr>
<tr>
<td>Overweight (n = 58, 44.3%)</td>
<td>26.8 (25.1 to 29.8)</td>
</tr>
<tr>
<td>Obese (n = 28, 21.4%)</td>
<td>32.0 (30.3 to 36.5)</td>
</tr>
</tbody>
</table>

N — the total number of respondents; n — number of responses.
by the square of height (m²). Comparison of mean age was performed using the independent-samples t-test and comparisons on numbers of rectal examinations were conducted through the Wilcoxon signed-rank test. The reported first, second, and third most physically demanding tasks were analyzed by both total frequency of reporting, and frequency within each rank (most difficult, second most difficult, and third most difficult).

A conventional qualitative content analysis (QCA) approach (20) was used to analyze responses to the 3 open-ended text questions on the impact of musculoskeletal discomfort. Preliminary notes and coding schemes to identify themes and sub-themes were first developed based on initial interpretations. Codes were reviewed again to explore potential links or sub-categories, and finally, references for each code were checked for cohesion and alignment. When written examples spanned multiple sub-themes, they were categorized by main theme only.

### Results

The response rate was 51.4% (133/259). Most responses (91.7%) were received by mail. Male participants accounted for 71.8% (94/131) of the respondents. Most participants (93.2%; 123/132) were right hand-dominant, 4.5% (6/132) were left-handed, and 2.3% (3/132) were ambidextrous. Female participants were on average younger than male, 42.0 versus 53.0 y old ($P = 0.001$). The median height and weight were 178.0 cm and 83.0 kg; body mass index had a median of 25.9 (range: 19.1 to 36.5). About 65.7% were classified as overweight or obese according to the World Health Organization obesity categories (Table 1) (21).

### Table 2. Veterinary work characteristics of participating western Canadian bovine practitioners.

<table>
<thead>
<tr>
<th>Variables</th>
<th>N</th>
<th>25th</th>
<th>50th</th>
<th>75th</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veterinarian partners (number)</td>
<td>130</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>0 to 20</td>
</tr>
<tr>
<td>Graduation from veterinary school (calendar year)</td>
<td>131</td>
<td>1982</td>
<td>1992</td>
<td>2005</td>
<td>1964 to 2015</td>
</tr>
<tr>
<td>Being a bovine practitioner (years)</td>
<td>133</td>
<td>11.0</td>
<td>24.0</td>
<td>33.0</td>
<td>2.0 to 50.0</td>
</tr>
<tr>
<td>Types of attributed practice (portion)</td>
<td>131</td>
<td>0.0</td>
<td>3.0</td>
<td>45.0</td>
<td>0.0 to 100.0</td>
</tr>
<tr>
<td>Dairy (%)</td>
<td>131</td>
<td>20.0</td>
<td>50.0</td>
<td>75.0</td>
<td>0.0 to 100.0</td>
</tr>
<tr>
<td>Beef (%)</td>
<td>130</td>
<td>0.0</td>
<td>3.0</td>
<td>10.0</td>
<td>0.0 to 65.0</td>
</tr>
<tr>
<td>Equine (%)</td>
<td>130</td>
<td>0.0</td>
<td>0.0</td>
<td>3.3</td>
<td>0.0 to 100.0</td>
</tr>
<tr>
<td>Other large animal (%)</td>
<td>130</td>
<td>0.0</td>
<td>5.0</td>
<td>42.0</td>
<td>0.0 to 85.0</td>
</tr>
<tr>
<td>Small animal (%)</td>
<td>131</td>
<td>0.0</td>
<td>5.0</td>
<td>42.0</td>
<td>0.0 to 85.0</td>
</tr>
<tr>
<td>Hand use in rectal examination (percentage of time)</td>
<td>131</td>
<td>0.0</td>
<td>25.0</td>
<td>100.0</td>
<td>0.0 to 100.0</td>
</tr>
<tr>
<td>Right</td>
<td>131</td>
<td>0.0</td>
<td>70.0</td>
<td>100.0</td>
<td>0.0 to 100.0</td>
</tr>
<tr>
<td>Left</td>
<td>130</td>
<td>0.0</td>
<td>0.0</td>
<td>95.0</td>
<td>0.0 to 100.0</td>
</tr>
<tr>
<td>Ultrasound use in rectal examination (percentage of time)</td>
<td>102</td>
<td>70.0</td>
<td>90.0</td>
<td>95.0</td>
<td>0.0 to 100.0</td>
</tr>
<tr>
<td>Rectal examinations (number per year)</td>
<td>128</td>
<td>0</td>
<td>100</td>
<td>5000</td>
<td>0 to 64 000</td>
</tr>
<tr>
<td>Dairy cows/heifers</td>
<td>128</td>
<td>0</td>
<td>100</td>
<td>4000</td>
<td>0 to 25 000</td>
</tr>
<tr>
<td>Beef cows/heifers</td>
<td>128</td>
<td>0</td>
<td>300</td>
<td>600</td>
<td>0 to 1800</td>
</tr>
</tbody>
</table>

N = total number of respondents.

### Table 3. Prevalence of musculoskeletal discomfort among western Canadian bovine practitioners.

<table>
<thead>
<tr>
<th>Body region</th>
<th>Experienced discomforta</th>
<th>Interrupted normal workb</th>
<th>Interrupted bovine tasksb</th>
</tr>
</thead>
<tbody>
<tr>
<td>One or both shoulders</td>
<td>85 (63.9%)</td>
<td>10 (7.5%)</td>
<td>9 (6.8%)</td>
</tr>
<tr>
<td>Lower back</td>
<td>75 (56.4%)</td>
<td>17 (12.8%)</td>
<td>10 (7.5%)</td>
</tr>
<tr>
<td>Neck</td>
<td>68 (51.1%)</td>
<td>5 (3.8%)</td>
<td>4 (3.0%)</td>
</tr>
<tr>
<td>One or both elbows</td>
<td>58 (43.6%)</td>
<td>3 (2.3%)</td>
<td>2 (1.5%)</td>
</tr>
<tr>
<td>One or both hands</td>
<td>56 (42.1%)</td>
<td>6 (4.5%)</td>
<td>5 (3.8%)</td>
</tr>
<tr>
<td>One or both knees</td>
<td>49 (36.8%)</td>
<td>8 (6.0%)</td>
<td>7 (5.3%)</td>
</tr>
<tr>
<td>Upper back</td>
<td>38 (28.6%)</td>
<td>5 (3.8%)</td>
<td>5 (3.8%)</td>
</tr>
<tr>
<td>One or both hips/thighs</td>
<td>32 (24.1%)</td>
<td>3 (2.3%)</td>
<td>1 (0.8%)</td>
</tr>
<tr>
<td>One or both ankles</td>
<td>15 (11.3%)</td>
<td>1 (0.8%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>Any body region</td>
<td>119 (89.5%)</td>
<td>35 (26.3%)</td>
<td>25 (18.8%)</td>
</tr>
<tr>
<td>1 to 3 regions</td>
<td>54 (40.6%)</td>
<td>33 (24.8%)</td>
<td>23 (17.3%)</td>
</tr>
<tr>
<td>4 or more regions</td>
<td>65 (48.9%)</td>
<td>2 (1.5%)</td>
<td>2 (1.5%)</td>
</tr>
</tbody>
</table>

N = total number of respondents.

a Experienced musculoskeletal discomfort at this particular body site in the previous 12 months.
b Musculoskeletal discomfort serious enough to prevent the veterinarian from performing normal work (at home or away from home) in the previous 12 months.
c Musculoskeletal discomfort serious enough to prevent the veterinarian from performing bovine tasks in the previous 12 months.

The work profile of the veterinarians in the present study is presented in Table 2. Participants had an average of 3 veterinarian partners (range: 0 to 20) in their practice; the median graduation year for participating veterinarians was 1992 (range: 1964 to 2015), and the median years practicing was 24.0 (range: 2.0 to 50.0 y). On average, respondents apportioned about 50.0% of their time to beef cattle practice, which was the greatest portion of all types; other types included dairy (3.0%),...
Table 4. Impact of musculoskeletal symptoms on work among western Canadian bovine practitioners.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Definition</th>
<th>Written examples from survey</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mild or no work-related symptoms:</strong></td>
<td>Reported never experiencing significant work-related musculoskeletal symptoms (WRMS)</td>
<td></td>
</tr>
<tr>
<td>Mild or no symptoms</td>
<td>Very mild or no WRMS</td>
<td>“Did not impact my work because the pain is not very bad.”</td>
</tr>
<tr>
<td>Asserting symptoms not work-related</td>
<td>MS symptoms that were not related to veterinary work</td>
<td>“I have never had real chronic pain or severe acute pain that stopped me from work. However I am also lucky that I have always worked in a multiple vet practice to allow sharing the load of the physical tasks.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Most of my musculoskeletal problems are unrelated to my work.”</td>
</tr>
<tr>
<td><strong>Pain with no impairment:</strong></td>
<td>Reported experiencing significant WRMS pain that did not affect work tasks</td>
<td></td>
</tr>
<tr>
<td>Desensitization</td>
<td>Ability to overcome or recover quickly from WRMS</td>
<td>“Usually keep on going and pain disappears.”</td>
</tr>
<tr>
<td>Working through pain</td>
<td>WRMS during routine tasks</td>
<td>“The key is to be physically strong and flexible so you can handle tasks and/or recover quickly. If the body is weak and rigid problems will occur. Society is soft and weak.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“It just makes it harder to do. I will still work with pain, but things take longer and it takes longer to heal.”</td>
</tr>
<tr>
<td><strong>Reduced productivity:</strong></td>
<td>Reported some form of reduced veterinary productivity due to WRMS pain</td>
<td></td>
</tr>
<tr>
<td>Altered technique</td>
<td>Changed how a task was done to avoid/minimize WRMS</td>
<td>“If pain is felt then a change of technique or strengthening of the muscles needed for the task is required.”</td>
</tr>
<tr>
<td>Worked more slowly</td>
<td>Worked slower to minimize WRMS</td>
<td>“Other areas of body begin having issues due to altered stance/compensation for discomfort — back especially.”</td>
</tr>
<tr>
<td>Difficulty with routine tasks</td>
<td>Routine tasks became difficult or impossible due to WRMS</td>
<td>“I’m slower, I do more small animals. I have to rest more when I am working.”</td>
</tr>
<tr>
<td>Reduced workload</td>
<td>Reduced workload to manage WRMS</td>
<td>“Surgeries/dentals, exams are all more difficult if you can’t rotate your neck.”</td>
</tr>
<tr>
<td>Work absence</td>
<td>Time off work to manage or recover from WRMS</td>
<td>“When I have tendonitis in my right wrist/elbow I am unable to perform both bovine-related work and small animal work.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Have to book lighter and space out appointments.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“I have had to cut back to 50% small animals due to issues.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Occasional afternoon off, have taken some time off for chiropractic and massage help.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Have had to miss work approx. 1 month straight two years ago, and have missed several days off and on since. Have had to stop performing calvings, C-sections/prolapses because of lower back injury.”</td>
</tr>
<tr>
<td><strong>Temporary or permanent impairment:</strong></td>
<td>Reported sustaining a work-related bodily impairment</td>
<td></td>
</tr>
<tr>
<td>Nerve injury</td>
<td>Sustained a nerve injury</td>
<td>“Brachial plexus syndrome — forced to reduce number of palpation, shoulders, elbows, and now I have had to reduce activity, now practice is about 20% of original volume.”</td>
</tr>
<tr>
<td>Upper-limb impairment</td>
<td>Impairment related specifically to arm, hand</td>
<td>“Carpal tunnel surgery on both hands.”</td>
</tr>
<tr>
<td>Animal-related traumatic injury</td>
<td>Sustained a traumatic injury caused by a large animal</td>
<td>“At one time I could not put my elbow on the car door armrest because of pain.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Arthritis in thumbs makes surgery difficult holding tissue forceps with left hand, writing medical records with right hand. Lack of hand strength due to pain in thumbs.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“I have decreased my [large animal] practice after rotator cuff injury &amp; concussion.”</td>
</tr>
<tr>
<td><strong>Quality of life:</strong></td>
<td>Reported quality of life being directly affected by WRMS pain</td>
<td></td>
</tr>
<tr>
<td>Chronic pain</td>
<td>Experienced chronic or persistent WRMS</td>
<td>“Chronic headaches and severe facial pain make it difficult to have good client interactions and focus.”</td>
</tr>
<tr>
<td>Emotional stress</td>
<td>Experienced stress, low mood, or anxiety</td>
<td>“Decreased any lifting with my right [arm]. Made me miserable and concerned for my longevity.”</td>
</tr>
<tr>
<td>Pain while driving</td>
<td>Reported driving being a potential cause/aggravator</td>
<td>“Rural mixed/bovine practice is physically and emotionally demanding, I strongly believe that the emotional demands of practice contribute to physical outcomes.”</td>
</tr>
<tr>
<td>Sleep impairment</td>
<td>Sleep interruptions</td>
<td>“Many large animal vets do a lot of driving, I think much of my back soreness comes from driving, not bovine practice. I drive about 70 000 km a year.”</td>
</tr>
<tr>
<td>Participation affected</td>
<td>Reduced ability to engage in normal activities outside of work</td>
<td>“I continued to work but made tasks more difficult to complete and nights sometimes painful, so changed sleep patterns.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Does not affect my work as I still perform tasks. Simply affects my ability to sleep at night and enjoy a pain-free quality of life.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Makes it harder to do other things, hockey, play with kids, ride my horses, etc.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“If I had not quit doing calvings, the lower back injury would have progressed and affected my life outside of work.”</td>
</tr>
</tbody>
</table>
Table 4 presents a thematic analysis of the written responses describing musculoskeletal discomfort and their impact on work. Six overarching themes and 21 smaller sub-themes were identified with written examples from the surveys.

Difficult tasks, as reported by bovine practitioners, are presented in Table 5. The top 3 strenuous task categories were obstetrical procedures (42.0%) including dystocia (calving), cesarian-section, uterine prolapse, fetotomy, and embryotomy; rectal examinations (28.6%); and breeding soundness evaluation (10.9%). Other physically demanding tasks were conducting bovine surgeries (8.7%) including dehorning, castrating, hoof trimming, and left/right displaced abomasum surgeries; necropsies (3.6%); and dealing with down cows (2.2%), followed by cattle handling (1.1%), spraying heifers (0.8%), field examinations (0.6%), cattle exportation: age verification (0.3%), tasks that require bending at the waist or being on knees (0.3%), tasks requiring running, climbing, pushing, and standing (0.6%), and sitting at a computer (0.3%).

Discussion

This survey describes self-reported musculoskeletal symptoms and the impact on their work from 133 bovine veterinarians, 89.5% of whom reported musculoskeletal symptoms in the past 12 mo (Table 3). These results are consistent with findings among New Zealand veterinarians using the same survey tool (NMQ). Scuffham et al (7) reported that the annual prevalence rate of musculoskeletal discomfort was greatest in equine and large animal veterinarians (100%), compared with practices of mixed animals (96%) and small animals (94%).

In the current study, shoulder symptoms were the most frequently reported (63.9%) by bovine practitioners, and the second and third areas of discomfort were the lower back (56.4%) and neck (51.1%) (Table 3). Discomfort in the shoulder, lower back, and neck has also been commonly observed in prior studies among veterinarians in all practice types, presenting in a slightly different sequence. For example, Scuffham et al (7) reported that among New Zealand veterinarians, lower back symptoms were the most common (73%), followed by shoulders (59%), the neck (58%), and wrists/hands (52%). Kozak et al (10) only studied the upper limbs of German veterinarians,

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Table 4. Impact of musculoskeletal symptoms on work among western Canadian bovine practitioners (continued).

<table>
<thead>
<tr>
<th>Theme</th>
<th>Definition</th>
<th>Written examples from survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Considered leaving practice</td>
<td>Willingness to leave profession if WRMS symptoms worsen</td>
<td>&quot;Will quit early to prevent.&quot;</td>
</tr>
<tr>
<td>Retired earlier than expected</td>
<td>WRMS symptoms a major factor in decision to retire</td>
<td>&quot;The issue I have had is work-related injuries and repetitive strain injuries, which have not ever healed properly due to lack of sleep (chronic sleep interruptions from being on call) and lack of time to be able to seek treatment. This has led to chronic musculoskeletal pain and will likely be the cause of my retirement from vet med.&quot;</td>
</tr>
<tr>
<td>Changed careers</td>
<td>Left practice prior to retirement due to inability to manage WRMS symptoms</td>
<td>&quot;Had no choice because of pain.&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;I have left regular bovine practice. I did 28 years of lots of pregnancy testing. Now I sell and train vets on ultrasound.&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;I was 25 and on painkillers for all of calving, surgery had not cured problem, no diagnosis available. I wonder if with exercise therapy or other new techniques I could have managed the pain.&quot;</td>
</tr>
</tbody>
</table>

small animals (5.0%), and equine (3.0%). The average number of rectal examinations performed annually was highest in beef cows/heifers category (4000), significantly higher than that conducted in beef bulls for breeding soundness examinations (300, \( P < 0.001 \)) or dairy cows/heifers (100, \( P = 0.009 \)). When performing rectal examinations, veterinarians reported typically using their left hand 70.0% of the time and using an ultrasound 30.0% of the time.

Almost all bovine practitioners (97%, 128/132) who completed the survey reported experiencing musculoskeletal ailments (ache, pain, or discomfort) in their lifetime. During the 12 mo prior to the survey, 89.5% had symptoms in at least 1 body region, and 48.9% had discomfort in 3 to 4 body regions. With respect to their overall health, about 51.5% reported "very good," 27.3% "excellent," 19.7% "good," 1.5% "fair," and none reported being in "poor" health.

The 12-month prevalence of musculoskeletal symptoms, as well as its interruption of routine and cattle-related tasks, is shown in Table 3. One or both shoulders were the most prevalent body region having symptoms reported by 63.9% of veterinarians. Over half of the practitioners had symptoms in their lower back (56.4%) and neck (51.1%). There was also a significant portion of participants experiencing symptoms related to other areas such as elbows (43.6%), hands (42.1%), knees (36.8%), hips/thighs (24.1%), upper back (28.6%), and ankles (11.3%).

Symptoms in the lower back were the most common of all types of musculoskeletal discomfort impedng normal work or bovine tasks in 12.8% and 7.5% of participants, respectively. Shoulder discomfort impeding work or bovine tasks for 7.5% and 6.8%, and knee discomfort 6.0% and 5.3%, respectively. Roughly a quarter (26.2%) of survey respondents had considered quitting bovine practice because of musculoskeletal symptoms.

Bovine practitioners sought varied treatments to alleviate musculoskeletal symptoms. Over-the-counter medication was commonly used (75.2%), followed by physiotherapy (43.6%), chiropractic therapy (41.4%), massage therapy (46.6%), exercise therapy (37.6%), prescription medication (25.6%), acupuncture (19.5%), and surgery (12.8%).
Table 5. Identification of the physically demanding tasks during bovine practice reported by western Canadian bovine practitioners.

<table>
<thead>
<tr>
<th>Task name</th>
<th>Task description</th>
<th>Total responses in any order</th>
<th>1st rank</th>
<th>2nd rank</th>
<th>3rd rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstetrical procedures</td>
<td>Includes assisting with parturition; dystocia or calving, C-sections, prolapses uterus, fetotomy, and embryotomy</td>
<td>150</td>
<td>73</td>
<td>56</td>
<td>21</td>
</tr>
<tr>
<td>Rectal examination</td>
<td>May be used for pregnancy checks, herd health checks, or embryo transfer and part of clinical exams</td>
<td>102</td>
<td>33</td>
<td>39</td>
<td>30</td>
</tr>
<tr>
<td>Breeding soundness evaluation</td>
<td>Semen collection, scrotal palpation and measurement, rectal exam, and may include preputial scraping</td>
<td>39</td>
<td>4</td>
<td>13</td>
<td>22</td>
</tr>
<tr>
<td>Bovine surgeries</td>
<td>Includes dehorning, castration, hoof trimming, left/right displaced abomasum surgery, abdominal exploration, penile urethrostomy, and umbilical surgeries</td>
<td>31</td>
<td>8.7%</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td>Necropsy</td>
<td>Inspection of carcass to assess health indicators, may include sectioning and lifting sections</td>
<td>13</td>
<td>3.6%</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Dealing with down cows</td>
<td>Physical examination of animals who are unable to stand. May include sitting/kneeling squatting on the ground and potentially lifting or pulling on animal</td>
<td>8</td>
<td>2.2%</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Cattle handling</td>
<td>Includes moving animals through chute system, working head gates, animal restraint both with and without handling facilities</td>
<td>4</td>
<td>1.1%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Spaying heifers</td>
<td>Surgical procedure for sterilization</td>
<td>3</td>
<td>0.8%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Field examinations</td>
<td>Can include clinical examinations in the field, including blood collection from tail vein and rectal palpation</td>
<td>2</td>
<td>0.6%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cattle exportation: age verification</td>
<td>Can include clinical exam of animal for age indicators, including teeth, hoof, and reproductive tract status</td>
<td>1</td>
<td>0.3%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tasks require bending at the waist or on knee</td>
<td>Can occur during obstetrics, dealing with down cows, breeding soundness exams, and necropsy</td>
<td>1</td>
<td>0.3%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tasks require running, climbing, pushing, and standing</td>
<td>Can occur during animal handling tasks described above</td>
<td>2</td>
<td>0.6%</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Sitting at computer</td>
<td>Administrative and clerical tasks related to clinical practice</td>
<td>1</td>
<td>0.3%</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Note: * 128 survey participants provided any response to the ‘most demanding task’ question, 122 responded to the ‘second most demanding task’ and 107 provided a response to the ‘third hardest task’ question. The total number of ‘demanding task’ responses was 122 + 128 + 107 = 357. Percentages in each column are based on these denominators.

reporting symptoms in the neck (67%) and shoulders (61%) as the most affected body regions, followed by hand (34.5%) and elbow (24.5%).

The differences in prevalence between the present study and the studies by Kozak et al (10) and Scuffham et al (7) may be explained by differences in the veterinarians who were sampled, varying from the type of practice to type of animals. The present survey focused only on bovine practitioners, and veterinarians predominantly practicing on beef cattle. According to the 2016 Census of Agriculture, 80% of Canada’s beef production is in western Canada (British Columbia, Alberta, Saskatchewan, and Manitoba) (16). Whereas eastern Canada (provinces locates at the east of Manitoba, such as Ontario and Quebec) owned 77% of Canadian dairy cows as of January 2017 (22). Scuffham et al (7) surveyed New Zealand veterinarians practicing in equine (15.1%), large animal (10.5%), mixed animal (38.2%), small animal (28.8%), and other (7.4%) practices. Kozak et al (10) studied German veterinarians working with small animals (48.6%), mixed animals (20.1%), and large animals (31.3%).

Overall, musculoskeletal symptoms impeded normal work in 26.3% of participating bovine practitioners and impeded bovine tasks in 18.8% (Table 3). Low back pain showed the highest impact in terms of normal and bovine work interruptions, followed by symptoms involving shoulders and knees, which is
consistent with previous research. Among veterinarians of all practices, Scuffham et al (7) found that low back symptoms had the most significant effect on activities (42%) and absence from work (9%), while discomfort in the shoulders, wrists/hands, and neck demonstrated a secondary interruption for activity (25 to 28%) and work (3% to 4%).

While only 26.3% of survey respondents stated that musculoskeletal discomfort had interrupted normal work in the past 12 mo, 97% (129/133) of all respondents provided a written answer describing how their work had or had not been interrupted. Only a small number (23 out of the 129 written responses) described no or minimal impact on work, though several of these responses subsequently described specific work preparation techniques or coping mechanisms required to ensure pain did not impact work. It appears that most respondents do not consider difficulties such as working through pain or altering technique to avoid pain to be true interruptions when answering a yes/no question, but there is nonetheless impact on work. Perhaps the most troubling responses within the “quality of life” theme were those describing an inability to participate in regular “life” activities due to pain, such as picking up children or participating in sports. In a workforce in which the predominant culture and ethos may be to “tough it out” and minimize complaint (23), the data collection method (binary checkmark versus narrative of effects) may have an impact on a researcher’s interpretation of the scope and nature of the issue. A mixed-methods approach to capturing both symptoms and impact on work would be advisable in future studies of workforces exhibiting high levels of stoicism.

The present study’s findings of top physically demanding tasks as presented in Table 5 [obstetric procedures (42.0%), rectal examinations (28.6%), and breeding soundness evaluation (10.9%)] were similar to top causes perceived by 100 surveyed California veterinarians for cumulative trauma disorders: rectal palpation (64%), calving manipulations (30%), and general work-related lifting (25%) (24). A very small portion of large animal practitioners in the present study identified dehorning (1.4%) as a demanding task, as compared to 37% of New Zealand large animal veterinarians, who also reported ultrasound usage (32%), rectal palpation (26%), and obstetric procedures (24%) as the most likely contributors to musculoskeletal discomfort (13).

Other veterinary tasks previously named as difficult were also consistent in the present study, such as animal handling, foot trimming, performing surgery, sitting at a computer, tasks involving bending of the waist or knees, and driving (Table 5). Driving as an ergonomic hazard has been mentioned in previous studies as well; a Swedish study found that veterinarians are potentially exposed to a large number of ergonomic hazards related to working out of a vehicle “office” (25).

Multiple studies have indicated the potential association of rectal palpations with musculoskeletal injuries, especially in the upper limb and knee areas on the side of the body used for palpations (13,24,26). Rectal examinations account for a large portion of American bovine practitioners’ professional time (26), and 75% of Australian veterinarians’ cattle-related injuries have been anecdotally attributed to pregnancy testing, mostly in the shoulders, elbows, and knees (27). In the current study, the participants reported performing a median of 8200 rectal palpations per year, and only 2.0% of respondents reported never performing a rectal examination. Most examinations were performed on beef cows. Over a typical 30-year career, this amounts to a lifetime exposure of 246 000 examinations and presents a tremendous cumulative amount of exposure to the shoulder and upper limb. This average exposure may be an underestimate of peak annual volume, as several respondents noted that their palpation load was much higher earlier in their career. Comparatively, a study of registered German large animal veterinarians found 64.1% reported conducting 600 to 2400 rectal palpations per year, 19.6% reported less than 600, and 8.4% had never performed a rectal examination (10).

In concordance with the findings of Cattell et al (26), the combination of the present results and previous studies demonstrate a compelling need for further research to evaluate and mitigate the ergonomic exposures related to rectal palpation.

The veterinarians participating in the present survey are a representative sample of WCABP members (Table 1). The study sample has a similar gender and age distribution to the general WCABP members, on the percentage of male (71.7% versus 74.0%), as well as the average age of male (53.0 y versus 54.0 y) and female veterinarians (42.0 y versus 46.0 y). In comparison to the general Canadian population (28), the WCABP membership is more male dominant (74.0% versus 50.0%), and on average older (male 54.0 y versus 40.2 y and female 46.0 y versus 42.2 y). Body mass index results of the present survey in 2017 were close to the Canadian Community Health Survey data collected in 2014 with respect to percentage of obese adults (21.4% versus 20.2%), but different on percentage of overweight adults (44.3% versus 67.5%); which may due to the different gender and education distribution, i.e., a more male dominant and higher educational attainment in the present sample.

The response rate for the present study (51.4%) is considered moderate. Previous surveys on self-reported musculoskeletal discomfort have varied in response rates and scope of targeted veterinarians; for example, 64.0% (1038 Australian veterinarians) (9); 41.0% (867 New Zealand veterinarians) (7); 38.4% (8265 German veterinarians) (10); 10.0% (8310 Minnesota veterinarians) (29); and 9.6% (926 Irish veterinarians) (6). Our response rate was also consistent with the typical rate of mailed surveys published in medical journals, which tends to be moderate, with a mean rate of 54.0% from physicians and 68.0% from non-physicians (30). The primary concern with a low response rate is response bias. The bovine practitioners in the present study were slightly older (median male age 53.0 y, female 42.0 y) compared with Jelinski et al’s (31) study of Western Canadian veterinarians (male 49.4 y, female 40.7 y). More than 65.0% of the respondents in the present study were overweight, which is slightly higher than the 61.2% observed among all Canadian adults (32).

To our knowledge, this is the first study in a Canadian context to explore musculoskeletal issues and identify physically demanding tasks in bovine veterinary practice. The mixed method study design facilitates a better understanding of the scope of musculoskeletal issues among Canadian bovine
practitioners, targeting both the prevalence and the impact. The present survey employed a standardized musculoskeletal questionnaire for comparing across studies, along with providing both the returning envelopes and online options for participants.

A major limitation of this study is that the targeted sample is relatively small, focusing only on western Canadian bovine practitioners. Further, due to ethical reasons, the study was not able to obtain demographic information on the non-responsive portion (48.6%) of large animal veterinarians. The cumulative workload of bovine tasks was only questioned for rectal examinations, presuming it to be the most concerning task for practitioners (a survey design choice made based on the existing literature). Information on hours worked per day or per week may provide a better understanding of workload as a bovine practitioner; however, this was not collected in this survey. Additional questions on obstetrics or semen testing procedures, along with hours of work and driving, could be assessed in future studies to examine the total physical workload.

The focus on only physical risk factors contributing to musculoskeletal discomfort as reported by the bovine practitioners is another limitation. In addition to physical aspects, psychosocial risk factors are important for developing MSD. Smith et al (9) found significant correlations between MSD and a range of psychosocial factors, including work-related stress from career structure, clients, and insufficient holidays, lack of recognition from the public and colleagues, time pressures, and lack of understanding from partners and from family. Scuffham et al (7) also studied both physical and psychosocial factors in New Zealand veterinarians, whose findings supported the interaction between both contributing to MSD.

The survey design facilitated a greater understanding of musculoskeletal symptoms in Western Canadian bovine veterinarians. However, selection and information biases may exist in the present study (33). For example, the higher than average prevalence rate of musculoskeletal symptoms observed in the present study might be influenced by preferential participation by practitioners who had experienced symptoms and were therefore especially motivated to participate. On the other hand, the severity of musculoskeletal symptoms or the impact on work might be underestimated given that the surveyed bovine practitioners may be a physically healthier group, compared with those practitioners who may have left the profession due to MSD and are no longer members of WCABP. This is known as the "healthy worker effect" (34). This study adopted a standardized questionnaire to reduce information bias; however, the 12-month window for pain and impact on work might introduce recall bias. Further, there is evidence that workers with musculoskeletal complaints tend to overestimate their exposures (35,36). Since many of the veterinarians had pain, their self-reported exposure on numbers of rectal examinations performed per year may be underestimated.

A major strength of the conventional qualitative content analysis approach is that it is performed without adherence to preconceived frameworks, allowing themes to emerge from the data organically. Disadvantages of this approach involve the potential to misrepresent the data when attempting to develop a theory from the results or to miss key categories (20). There were several major limitations related to our thematic analysis. In contrast with an interview, the written responses did not allow for follow-up questions. The text-based questions were very broad, thus participants may have interpreted questions in different ways. The questions did not ask for specific injury descriptions or diagnoses, thus many respondents only described their musculoskeletal symptoms in general terms (e.g., "shoulder pain").

Shoulder, neck, and lower back symptoms were the most prevalent areas of musculoskeletal discomfort reported in the present study. While the impact of musculoskeletal symptoms on work tasks was perceived to have a "moderate" impact on checklist items, written responses were more likely to describe an impact on quality of life and work. The most commonly named physically demanding tasks were related to obstetrical and rectal procedures. Future research should focus on potential musculoskeletal risk factors and ergonomic exposure assessments of these strenuous tasks in real working environments, with a focus on the upper limbs and neck in large animal veterinarians. Consistent with the conclusion of previous studies, further research is also needed on prevention strategies, which may include such approaches as body conditioning, training of veterinarian trainees in biomechanically favorable techniques, or the development of ergonomic tools to reduce exposures.

Acknowledgment

We gratefully acknowledge the assistance of the Western Canadian Association of Bovine Practitioners, in particular, Phyllis Mierau and the veterinarians who participated in the study.

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References


You may not have the time, facilities, or experience to write scientific articles for review by experts. But you have interesting and valuable experiences that are worth sharing. We encourage you to share by submitting articles to Practitioners’ Corner, The Canadian Veterinary Journal. Simply e-mail your article to Ms. Heather Broughton (hbroughton@cvma-acmv.org). We will edit to ensure the format is correct then we will publish your article in The CVJ.
Prevalence of and risk factors for equine glandular and squamous gastric disease in polo horses

Heidi E. Banse, Heath MacLeod, Candice Crosby, M. Claire Windeyer

Abstract — The objectives of this study were to determine the prevalence rates and risk factors for equine glandular gastric disease (EGGD) and equine squamous gastric disease (ESGD) in a population of 63 polo horses in competition. The prevalence of EGGD grade $\geq 1$ was 69% and EGGD $\geq 2$ was 31%. The prevalence of ESGD grade $\geq 1$ was 54% and grade $\geq 2$ was 37%. The risk factors retained in the final multivariable models were years of experience in polo competition for EGGD grade $\geq 1$ and for grade $\geq 2$, with decreased experience being associated with EGGD and weekly exercise duration and non-steroidal anti-inflammatory drug (NSAID) use being associated with ESGD grade $\geq 1$. Decreasing weekly exercise duration was the only risk factor associated with ESGD grade $\geq 2$. Equine gastric disease was common in this population of polo horses and the amount of experience and weekly exercise duration were related to the risk of disease.

Résumé — Prévalence de la maladie gastrique glandulaire et squameuse des équidés et facteurs de risque chez les chevaux de polo. Les objectifs de cette étude consistaient à déterminer les taux de prévalence et les facteurs de risque pour la maladie gastrique glandulaire équine (MGGE) et la maladie gastrique squameuse équine (MGSE) dans une population de 63 chevaux de polo de compétition. La prévalence de la MGGE de grade $\geq 1$ était de 69 % et de la MGGE $\geq 2$ était de 31 %. La prévalence de la MGSE de grade $\geq 1$ était de 54 % et de grade $\geq 2$ était de 37 %. Les facteurs de risque conservés dans les modèles multivariables finaux étaient des années d’expérience dans les compétitions de polo pour la MGGE de grade $\geq 1$ et de grade $\geq 2$, et une expérience réduite était associée à la MGGE et la durée de l’exercice hebdomadaire et l’usage d’anti-inflammatoires non stéroïdiens (AINS) étaient associés à la MGSE de grade $\geq 1$. La réduction de l’exercice hebdomadaire était le seul facteur de risque associé à la MGSE de grade $\geq 2$. La maladie gastrique équine est commune dans cette population de chevaux de polo et la quantité d’expérience et la durée de l’exercice hebdomadaire étaient associées au risque de maladie.

(Traduit par Isabelle Vallières)
of other management factors, such as pasture turnout or forage type, remains unclear (1,13,20–22).

In contrast, there are few studies evaluating risk factors for EGGD. No association of age, breed, or gender with EGGD was discovered in one study (16), while another study found the Warmblood breed had an increased risk of EGGD (23). Additional epidemiological studies may identify dietary and management risk factors for different breeds and performance disciplines that contribute to the development of EGGD and ESGD.

Polo horses represent a unique equine performance population as they are often housed and trained in groups, rather than individually. The objectives of this study were to establish the prevalence and severity of gastric disease (ESGD and EGGD) and to identify risk factors for ESGD and EGGD in polo horses.

Materials and methods

Study population

This study was approved by the University of Calgary’s Veterinary Sciences Animal Care Committee (#AC14-003). Horses were recruited by a referring veterinarian (CC) who routinely provided veterinary care to 2 polo clubs in the Calgary area. In order to be included in the study, horses needed to be in training for or competing in polo. Horses were excluded if they had received any anti-ulcer medications (e.g., omeprazole, misoprostol, sucralfate, H2 antagonists) within 4 wk prior to gastroscopy. Sixty-three polo horses from 9 barns were examined by endoscopy from June to August 2014. No horses were excluded from the study; however, the authors did not track whether all eligible horses from a barn were offered for inclusion in the study.

Gastroscopy and gastric disease scoring

Before examination, horses were fasted for 12 to 16 h, sedated with detomidine (Dormosedan; Zoetis, New Jersey, USA), 0.01 to 0.02 mg/kg body weight (BW), IV, and examined with a 3-m endoscope (Karl Storz, Tuttinglen, Germany). Gastric lesions (ESGD and ESGD) were graded on a modified 4-point scale by 2 investigators (HEB, HM) at the time of endoscopy, according to endoscopy from June to August 2014. No horses were excluded from the study; however, the authors did not track whether all eligible horses from a barn were offered for inclusion in the study.

Two horses had incomplete examination of the glandular stomach due to residual feed in the stomach; these 2 horses did not

### Table 1. Prevalence of gastric disease in 63 polo horses.

<table>
<thead>
<tr>
<th>Grade</th>
<th>ESGD</th>
<th>EGGD</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 1</td>
<td>54%</td>
<td>69%</td>
</tr>
<tr>
<td>≥ 2</td>
<td>37%</td>
<td>31%</td>
</tr>
</tbody>
</table>

ESGD — equine squamous gastric disease; EGGD — equine glandular gastric disease.

Risk factor questionnaire

A questionnaire was developed through discussion and examination of the literature. Trainers completed a separate questionnaire for each enrolled horse under their care. The questionnaire included questions on signalment (age, gender, breed), medical history (previous medical conditions and treatments), exercise and performance history (exercise frequency and duration, number of years competing, performance level), dietary history (including type of feed and frequency of feedings), and management (duration of time at current barn, housing and turnout type and duration). The questionnaire is available on request from the corresponding author.

Statistical analysis

A Chi-square test was used to determine the relationship between the presence of ESGD (grade ≥ 2) and EGGD (grade ≥ 1 or grade ≥ 2).

Results from the questionnaire were used to evaluate risk factors for ESGD and EGGD. After a preliminary review of the data, several continuous variables were categorized for analysis because of sparse data. Based on the median value for the variable:

- total exercise minutes per week was categorized into ≤ 270 or > 270 min/wk;
- exercise intensity was classified as high/very high or moderate/low;
- games per month was categorized into < 10 or ≥ 10;
- level of performance was categorized into < 6 goal or > 6 goal;
- grain feeding was categorized as < 1 or ≥ 1 times/d;
- hay type was categorized into grass or other;
- hay frequency was categorized as ≥ 3 or ≤ 3 times/d;
- time at current barn was categorized into ≤ 2 or > 2 mo;
- and turnout was categorized as ≤ 6 or > 6 h/d.

Because of small numbers of non-Thoroughbred or Thoroughbred-cross horses (n = 2), breed was not included in the model.

For the risk factor analysis, 4 outcomes were explored: i) EGGD ≥ 1 versus 0; ii) EGGD ≥ 2 versus < 2; iii) ESGD ≥ 1 versus < 0; and, iv) ESGD ≥ 2 versus < 2. Associations between risk factors and the outcomes of EGGD and ESGD were assessed using logistic regression (SPSS; IBM Corporation, Armonk, New York, USA). A univariable logistic regression analysis was performed for all independent variables. Independent variables with P < 0.10 in the univariable logistic regression analysis were considered for the multivariable logistic regression analysis. Independent variables eligible for entry into the model were assessed for collinearity (Pearson or Spearman rank correlation coefficient for continuous and dichotomous variables, respectively). Collinearity was considered present if correlation coefficients were > 0.8. When collinearity was present, multiple models were constructed and only 1 of the collinear variables was included in each model. Aikake’s information criterion (AIC) was used to evaluate which model best fit the data, and the model with the lowest AIC was retained as the final model. Because horses were clustered by barn, barn was offered as a fixed effect. Backward elimination was used to remove variables with P > 0.05. Confounding of remaining variables was assessed by observing changes > 30% in the remaining coefficients.

Results

Two horses had incomplete examination of the glandular stomach due to residual feed in the stomach; these 2 horses did not
have an EGGD score assigned and were excluded from EGGD analysis but included in the ESGD analysis.

Breeds represented included 1 mixed breed (Quarter horse × Thoroughbred), 1 Criollo, 1 Paint, 3 Argentine polo ponies, and 57 Thoroughbred horses. There were 22 geldings and 41 mares. Mean age [± standard deviation (SD)] was 12 ± 5 y. One horse had a history of colic and 1 horse had a history of chronic diarrhea. There was no history of respiratory or gastric disease in any horse. No horse was receiving any treatments for gastric disease. Medications administered included non-steroidal anti-inflammatory drugs (NSAIDs; n = 11, phenylbutazone, n = 7; firocoxib, n = 4, and glucosamine, n = 6). Supplements fed included electrolytes (n = 22), mineral mix (n = 9), and psyllium (n = 4). No supplements with identifiable antacid properties were fed.

Overall prevalence of EGGD and ESGD is presented in Table 1. There was no association between ESGD grade ≥ 2 and either EGGD grade ≥ 1 (P = 0.59) or EGGD grade ≥ 2 (P = 0.09). Results of the univariable analysis for ESGD variables with P < 0.05 are reported in Table 2, and results of the univariable analysis for EGGD variables with P < 0.05 are reported in Table 3. As there was no significant clustering by barn when evaluating EGGD (P > 0.3) or ESGD (P > 0.8), effect of barn was not included in the final multivariable model.

In the multivariable analysis for ESGD grade ≥ 1, the risk factors that remained in the model were exercise minutes per wk and NSAID use, with horses exercised ≤ 270 min per wk having an increased odds of ESGD grade ≥ 1 [odds ratio (OR) = 1.3; 95% confidence interval (CI): 1 to 1.7; P < 0.003] and absence of NSAID use associated with an increased odds of ESGD grade ≥ 1 (OR = 2.4; 95% CI: 1.3 to 4.5; P = 0.009). In the multivariable model for EGGD grade ≥ 2, decreasing exercise duration was associated with an increased odds of EGGD grade ≥ 2 (OR = 1.4; 95% CI: 1 to 1.7; P = 0.04) and NSAID use was associated with an increased odds of EGGD grade ≥ 1 (OR = 1.4; 95% CI: 1 to 1.7; P = 0.04).

**Discussion**

This study indicates that gastric squamous and glandular disease prevalence among training and competing polo horses differs from those typically observed in racing Thoroughbreds, with higher risk of EGGD and lower risk of ESGD (2,3,20). This suggests that factors associated with performance discipline may play a role in gastric disease formation. There are several ways in which management may differ between previous reports of racing Thoroughbreds and the polo horses of the present

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**Table 2. Univariable analysis of factors associated with ESGD grade ≤ 1 or ESGD ≥ 2 (P ≤ 0.05).**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>ESGD grade ≥ 1</th>
<th>ESGD Grade ≥ 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% affected</td>
<td>Odds ratio</td>
</tr>
<tr>
<td></td>
<td>or Mean ± SD</td>
<td>P-value</td>
</tr>
<tr>
<td>Years owned</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unaffected: 3.1 ± 1.9</td>
<td>Referent 2.0</td>
<td>0.003</td>
</tr>
<tr>
<td>Affected: 2.4 ± 1.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time at current barn</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 2 mo</td>
<td>46% (18/39)</td>
<td>Referent</td>
</tr>
<tr>
<td>&gt; 2 mo</td>
<td>85% (11/13)</td>
<td>6.4</td>
</tr>
<tr>
<td>Exercise duration (min/wk)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 270</td>
<td>18% (5/28)</td>
<td>Referent</td>
</tr>
<tr>
<td>&gt; 270</td>
<td>83% (29/35)</td>
<td>20</td>
</tr>
<tr>
<td>Travelling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>31% (11/35)</td>
<td>Referent 8.3</td>
</tr>
<tr>
<td>Yes</td>
<td>79% (19/24)</td>
<td></td>
</tr>
<tr>
<td>Hay frequency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 3 times/d</td>
<td>38% (14/37)</td>
<td>Referent</td>
</tr>
<tr>
<td>≤ 3 times/d</td>
<td>77% (20/26)</td>
<td>5.6</td>
</tr>
<tr>
<td>Bran</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>28% (5/18)</td>
<td>Referent</td>
</tr>
<tr>
<td>No</td>
<td>64% (29/45)</td>
<td>4.8</td>
</tr>
<tr>
<td>Electrolytes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>36% (8/22)</td>
<td>Referent 3.0</td>
</tr>
<tr>
<td>No</td>
<td>63% (26/41)</td>
<td></td>
</tr>
<tr>
<td>Housing: paddock</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>42% (15/36)</td>
<td>Referent 3.3</td>
</tr>
<tr>
<td>No</td>
<td>70% (19/27)</td>
<td></td>
</tr>
<tr>
<td>Turnout duration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 6 h</td>
<td>19% (3/16)</td>
<td>Referent 8.4</td>
</tr>
<tr>
<td>&gt; 6 h</td>
<td>66% (31/47)</td>
<td></td>
</tr>
<tr>
<td>NSAID use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>18% (2/11)</td>
<td>Referent 7.1</td>
</tr>
<tr>
<td>No</td>
<td>62% (32/52)</td>
<td></td>
</tr>
</tbody>
</table>

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882
study. For example, a previous study reported that turnout in groups and training at the site of housing significantly reduced odds of ESGD (13). The polo horses herein were frequently housed in groups and trained on-site (personal observations), which may have contributed to the lower prevalence observed. Furthermore, polo horses are generally older than racehorses, which may influence the formation of squamous lesions. One study reported differences in squamous mucosal response to VFAs in older compared to younger adult horses, which may alter risk of ESGD (25).

In this study population, duration of exercise and absence of NSAID use were associated with ESGD grade ≥ 1, while duration of exercise was the only factor associated with ESGD grade ≥ 2. Surprisingly, in both models, horses that were exercised less had an increased risk of ESGD. This is in contrast to previous studies which reported that increased racing and training led to increased risk of ESGD (2,19). This may in part be due to the different type and intensity of exercise training or changes in feeding practices prior to training associated with racing compared to polo. In humans, gastric ulcers are not consistently associated with physical activity, and activity has been reported to be protective against duodenal ulcer in men (26). The negative association between NSAID use and gastric disease formation should be interpreted cautiously, because multiple prior experimental studies have suggested that NSAIDs may induce gastric disease, particularly glandular disease (27–33). However, 2 cross-sectional studies in Thoroughbreds did not demonstrate an association between NSAIDs use and squamous disease (2,4) or glandular disease (2). Dose and duration of NSAID use, type of NSAID used, and the potential interaction between NSAID use and other management factors may influence the differences observed among field and experimental studies.

Of the 11 horses receiving NSAIDs in the present study, 1 received phenylbutazone twice daily (dose unknown) for 10 d, 6 received phenylbutazone “as needed” (dose unknown), and 4 received firocoxib (57 mg) daily. Intermittent dosing of phenylbutazone is likely to have a lower risk of inducing gastric disease, compared to daily administration. Furthermore, COX-2 selective NSAIDs may be safer for the gastric mucosa than phenylbutazone. A prior study in horses suggested that treatment with phenylbutazone increased gastric permeability over time, while the COX-2 preferential NSAID, meloxicam, did not (34). However, whether COX-2 selective NSAIDs such as firocoxib, are safer for the gastric mucosa remains unknown. It must also be considered that this counter-intuitive finding may be spurious, given the relatively small sample size of this study.

The only risk factor that remained in the final multivariable analysis for EGGD (grade ≥ 1 or grade ≥ 2) was years playing polo. For every year of less experience playing polo, odds of having EGGD increased. This suggests that experience may be protective against gastric glandular disease. It has been previously demonstrated that horses with competition experience may have lower basal cortisol at a horse show or in response to a jumping event (35,36). In humans, psychological stress has been proposed to contribute to peptic ulcer disease (37,38). As experience in the discipline increases, horses may become accustomed to training and competition practices, which may limit stress response and thus development of glandular disease. It is also possible that horses that are more experienced may be able to train for the same duration of time or at the same perceived intensity with less effort.

In this study, risk factors identified differed between the 2 types of gastric disease; there was no relationship between presence of ESGD and presence of EGGD. Previous studies in Thoroughbreds and sport horses have yielded conflicting results regarding the association between squamous and glandular disease (16,39). Taken together, these findings highlight the importance of considering risk factors for ESGD and EGGD separately.

There are several limitations to this study. One limitation was the recruitment strategy, which may have led to increased participation from barns with a higher prevalence of gastric disease. Furthermore, only a small number of horses participated in the study, and a large number of management factors were assessed, which may have led to a Type I or Type II error. The final multivariable models either had confidence intervals that were very close to overlapping 1 (i.e., EGGD models) or had very wide confidence intervals (i.e., ESGD models), which limits our confidence in applying these models to a larger population. Inclusion of additional horses in the study may have allowed for improved multivariable models.

This study provides new information on potential risk factors for squamous and glandular disease in polo horses. Decreasing weekly exercise duration was associated with ESGD, while decreased experience was associated with EGGD. Additional studies, such as prospective cohort or randomized clinical trials.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>EGGD grade ≥ 1 affected/total or Mean ± SD</th>
<th>Odds ratio</th>
<th>P-value</th>
<th>EGGD grade ≥ 2 affected/total or Mean ± SD</th>
<th>Odds ratio</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years playing</td>
<td>Unaffected: 9.4 ± 5.0</td>
<td>Referent</td>
<td>0.02</td>
<td>Unaffected: 8.6 ± 5.1</td>
<td>Referent</td>
<td>0.03</td>
</tr>
<tr>
<td>Electrolytes</td>
<td>No</td>
<td>—</td>
<td>50% (11/22)</td>
<td>3.9</td>
<td>21% (8/39)</td>
<td>Referent</td>
</tr>
<tr>
<td>Housing: pasture</td>
<td>Yes</td>
<td>42% (11/26)</td>
<td>Referent</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>69% (24/35)</td>
<td>2.9</td>
<td>0.04</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>
with larger numbers of Thoroughbred horses from various disciplines, may help to clarify the contribution of different management practices to equine glandular and squamous gastric disease.

Acknowledgment

We are grateful to Grace Kwong for assistance with statistical analysis.

References

Antimicrobial resistance in bacteria isolated from cats and dogs from the Atlantic Provinces, Canada from 1994–2013

Babafela B. Awosile, J. Trenton McClure, Matthew E. Saab, Luke C. Heider

Abstract — Antimicrobial susceptibility patterns and trends in bacteria isolated from cats and dogs were determined from diagnostic laboratory data from the Atlantic Veterinary College Diagnostic Services Bacteriology Laboratory over a 20-year period. Clinical samples were most commonly from the urinary tract and the ear. Staphylococcus spp. and Escherichia coli were the bacteria that were most frequently isolated. Increases in percentage resistant were seen with E. coli to cephalexin (57% to 61%), Pasteurella spp. to erythromycin (35% to 53%), and Pseudomonas aeruginosa (31% to 39%), and Streptococcus spp. (46% to 53%) to enrofloxacin. The frequency of resistance did not change significantly over the study period; however, increased enrofloxacin resistance was identified for canine isolates of Staphylococcus spp., Streptococcus spp., Enterococcus spp., E. coli, P. aeruginosa, and Proteus spp. Multidrug resistance was observed in 12% and 9% of the isolates from dogs and cats, respectively. Data from this study could be used to guide empirical antimicrobial selection in companion animal veterinary practices in Atlantic Canada.

Introduction

Antimicrobials, including agents of importance to human medicine, are commonly used in companion animal veterinary practice (1,2). Antimicrobial resistance (AMR) is an important problem in companion animals and has led to an increased risk of therapeutic failure, increased patient management cost, and public health complications (3). Because of the concerns about zoonotic transmission of antimicrobial resistance to humans, many have questioned the appropriateness of some antimicrobial use in animals (4). However, most of these concerns have been focused on use in food animals rather than companion animals (5). Information on AMR in companion animals is important data that can be used for directing rational early therapeutic decisions, for performing risk assessments of the effect AMR in bacteria from companion animals has on humans, and for developing antimicrobial stewardship guidelines and public policy (6).

Various studies have reported that resistance to several antimicrobials has increased in companion animal isolates over time (4,5,7). However, the extent and importance of AMR in companion animals are still poorly understood (8). The aim of this study was to determine antimicrobial susceptibility...
and AMR trends in the most common bacteria from dogs and cats isolated from clinical samples submitted to the Atlantic Veterinary College Diagnostic Services Bacteriology Laboratory (AVC DSBL).

Materials and methods
Antimicrobial susceptibility data for bacteria isolated from clinical samples submitted for culture and susceptibility testing from cats and dogs from 1994 to 2013 were retrieved from the database of the AVC DSBL. Bacteria were isolated using standard microbiological techniques, and antimicrobial susceptibility was determined using the Kirby-Bauer disk diffusion method. Zones of inhibition were interpreted according to Clinical and Laboratory Standards Institute (CLSI) guidelines that were current at the time susceptibility testing was performed.

Antimicrobial susceptibilities to the following antimicrobials were determined: amikacin, ampicillin, amoxicillin-clavulanate, cefovecin, cephalxin, chloramphenicol, clindamycin, doxycycline, enrofloxacin, erythromycin, fusidic acid, gentamicin, penicillin, and trimethoprim-sulfamethoxazole (TMS). Coagulase-positive Staphylococcus spp. (CPS) isolates, which were resistant to the β-lactam antimicrobials in the antimicrobial testing panel, were considered methicillin-resistant. An isolate resistant to at least 1 antimicrobial in at least 3 antimicrobial classes was categorized as multi-drug resistant (MDR). For methicillin-resistant Staphylococcus spp. MDR was defined as resistance to 2 drug classes other than the β-lactams.

Statistical analysis
Common bacterial isolates of cats and dogs that cause clinical disease and their antimicrobial susceptibility profile were selected from the data retrieved. Bacterial isolates were selected based on their clinical importance and their high frequency of isolation observed in the database. Data were tabulated using a computerized spreadsheet (Microsoft Excel, 2010; Microsoft, Redmond, Washington, USA) and all statistical analysis was done using Stata 14 (Stata Corp, College Station, Texas, USA). The clinical samples submitted and antimicrobial susceptibilities were presented as proportions with respective confidence intervals. Only acquired resistance was reported. All analyses were conducted on data from all isolated bacteria with antimicrobial susceptibility tests from 1994 to 2013, with the exception of cefovecin susceptibility data, which were only available from 2009 to 2013.

Logistic regression was used to detect an increasing or decreasing antimicrobial resistance trend over time. The year was modeled as a continuous variable, while each antimicrobial resistance (susceptible or resistant) was the binary outcome. Each bacterium-antimicrobial trend was modeled to determine the trend over time. Linearity assumption between the year and the outcome was evaluated by fitting quadratic polynomial for year in the model. Pearson's or Hosmer-Lemeshow goodness of fit test was used to evaluate how each model fits the data. The antimicrobial resistance trends were presented as odds ratio (OR). The Wald test was used to determine the statistical significance of each bacterium-antimicrobial trend. Chi-square test was used to test the difference in proportion of MDR between isolates from cats and dogs. The level of significance for all analyses was $P < 0.05$.

Results
Antimicrobial susceptibility of cat isolates
In cats, half of the clinical samples submitted over the study period (Table 1) were urine ($n = 1093$), followed by samples from the ear ($n = 375$), and nasal cavity ($n = 217$). While Escherichia coli was the most common bacterial isolate from urine (63.6%), Pasteurella spp. was more commonly isolated from the nasal cavity (45.6%). Staphylococcus spp. was commonly isolated from eyes (76.0%), skin (69.8%), ears (58.9%), and wounds (50.5%).

Antimicrobial susceptibilities for the bacteria are presented in Table 2. Overall, E. coli ($n = 829$), coagulase-negative staphylococci ($n = 355$), and Pasteurella multocida ($n = 309$) were the most frequently isolated bacteria over the study period. Frequency of resistance to most of the antimicrobials tested was low, except for higher frequency of resistance to penicillin in CPS, and resistance to enrofloxacin in Pseudomonas aeruginosa and Streptococcus spp. isolates. Multi-drug resistance was observed in 9% of cat isolates, ranging from 2.6% of Pasteurella spp. to 13% of E. coli (Table 2).

Changes in AMR over time are presented in Table 3. Overall, AMR trends in cat isolates did not significantly change over the study period. Significant increased resistance over time was observed to erythromycin for P. multocida, to amoxicillin-clavulanate and chloramphenicol for Enterococcus spp., and to enrofloxacin for Streptococcus spp. Significant decreased resistance over time was observed to aminoglycosides and erythromycin for CPS and aminoglycosides, amoxicillin-clavulanate, and cephalxin for E. coli.

Antimicrobial susceptibility of dog isolates
In dogs, samples from ears ($n = 6613$), urine ($n = 3863$), and skin ($n = 1112$) were the most commonly submitted clinical samples over the study period (Table 4). Staphylococcus spp. was commonly isolated from most of the clinical samples submitted over the study period including skin (76.8%), eyes (67.6%), joints (55.2%), nasal cavities (49.1%), surgical sites (45.8%), ears (39.8%), wounds (38.7%), and abscesses (36.4%). However, E. coli isolates were more commonly isolated from urine samples (52.4%) and anal sac glands (40.5%).

Antimicrobial susceptibilities for the bacteria are presented in Table 5. Staphylococcus spp. ($n = 5531$), E. coli ($n = 3364$) and Streptococcus spp. ($n = 1846$) were the most common bacteria isolated over the study period (Table 5). Higher frequency of resistance was observed to penicillin in Staphylococcus spp. and to enrofloxacin in P. aeruginosa and Streptococcus spp. Among the CPS, the majority of which were Staphylococcus pseudintermedius, methicillin-resistant CPS (MRCPs) were more MDR compared with methicillin-susceptible CPS (MSCPs). Multi-drug resistance was observed in 12% of the total isolates, ranging from 2.6% of Pasteurella spp. to 100% of MRCPs (Table 5).

Among the dog isolates, changes in AMR over time are presented in Table 6. Resistance to enrofloxacin significantly increased in all the canine bacterial isolates with the exception of
Table 1. Bacterial isolates from selected clinical samples from cats submitted to the diagnostic laboratory (1994–2013).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>% (95% CI)</td>
<td>% (95% CI)</td>
<td>% (95% CI)</td>
<td>% (95% CI)</td>
<td>% (95% CI)</td>
</tr>
<tr>
<td>Urine</td>
<td>1093</td>
<td>16.4 (14.2 to 18.7)</td>
<td>63.6 (60.7 to 66.4)</td>
<td>1.6 (0.9 to 2.5)</td>
<td>1.5 (0.8 to 2.4)</td>
<td>14.5 (12.4 to 16.7)</td>
</tr>
<tr>
<td>Ear</td>
<td>375</td>
<td>3.5 (1.8 to 5.9)</td>
<td>6.4 (4.1 to 9.4)</td>
<td>18.7 (14.9 to 22.9)</td>
<td>2.9 (1.5 to 5.2)</td>
<td>58.9 (53.8 to 63.9)</td>
</tr>
<tr>
<td>Nasal cavity</td>
<td>217</td>
<td>1.4 (0.2 to 3.9)</td>
<td>7.4 (4.3 to 11.7)</td>
<td>45.6 (38.9 to 52.5)</td>
<td>15.2 (10.7 to 20.7)</td>
<td>18.9 (13.9 to 24.7)</td>
</tr>
<tr>
<td>Wound</td>
<td>91</td>
<td>6.6 (2.5 to 13.8)</td>
<td>6.6 (2.5 to 13.8)</td>
<td>20.9 (13.6 to 30.7)</td>
<td>3.3 (0.6 to 9.3)</td>
<td>50.5 (39.9 to 61.2)</td>
</tr>
<tr>
<td>Abscess</td>
<td>82</td>
<td>6.1 (2.0 to 13.7)</td>
<td>9.7 (4.3 to 18.3)</td>
<td>36.5 (26.2 to 47.9)</td>
<td>3.7 (0.8 to 10.3)</td>
<td>22.0 (13.6 to 32.5)</td>
</tr>
<tr>
<td>Skin</td>
<td>63</td>
<td>4.8 (0.9 to 13.2)</td>
<td>3.2 (0.4 to 11.0)</td>
<td>9.5 (3.5 to 19.6)</td>
<td>1.6 (0.1 to 8.5)</td>
<td>69.8 (56.9 to 80.8)</td>
</tr>
<tr>
<td>Eyes</td>
<td>50</td>
<td>2.0 (0.1 to 10.6)</td>
<td>4.0 (0.5 to 13.7)</td>
<td>16.0 (7.2 to 29.1)</td>
<td>0.0</td>
<td>76.0 (61.8 to 86.9)</td>
</tr>
<tr>
<td>Surgical</td>
<td>27</td>
<td>22.2 (8.6 to 42.2)</td>
<td>14.8 (4.2 to 33.7)</td>
<td>14.8 (4.2 to 33.7)</td>
<td>3.8 (0.1 to 18.9)</td>
<td>25.9 (11.1 to 46.3)</td>
</tr>
</tbody>
</table>

Table 2. Antimicrobial susceptibilities in selected bacteria isolated from clinical samples of cats (1994–2013).

<table>
<thead>
<tr>
<th>Isolates</th>
<th>n</th>
<th>AMK</th>
<th>AMP</th>
<th>AMC</th>
<th>CHL</th>
<th>CLD</th>
<th>CEX</th>
<th>CEV</th>
<th>DOX</th>
<th>ERY</th>
<th>ENR</th>
<th>FUS</th>
<th>GM</th>
<th>PEN</th>
<th>TMS</th>
<th>MDR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. coli</td>
<td>829</td>
<td>93.9</td>
<td>73.7</td>
<td>87.9</td>
<td>97.2</td>
<td>60.9</td>
<td>94.4</td>
<td>89.0</td>
<td>IR</td>
<td>IR</td>
<td>97.6</td>
<td>IR</td>
<td>96.1</td>
<td>IR</td>
<td>96.7</td>
<td>13.3</td>
</tr>
<tr>
<td>Staphylococcus spp., coagulate negative</td>
<td>355</td>
<td>97.7</td>
<td>75.2</td>
<td>97.5</td>
<td>99.4</td>
<td>89.3</td>
<td>95.2</td>
<td>96.5</td>
<td>97.4</td>
<td>84.8</td>
<td>96.3</td>
<td>94.4</td>
<td>95.8</td>
<td>74.9</td>
<td>94.6</td>
<td>13.2</td>
</tr>
<tr>
<td>Pasteurella spp.</td>
<td>309</td>
<td>45.6</td>
<td>99.7</td>
<td>99.7</td>
<td>99.7</td>
<td>98.7</td>
<td>97.5</td>
<td>99.7</td>
<td>35.6</td>
<td>98.7</td>
<td>IR</td>
<td>65.6</td>
<td>98.7</td>
<td>99.0</td>
<td>2.6</td>
<td></td>
</tr>
<tr>
<td>Staphylococcus spp., coagulate positive&lt;sup&gt;a&lt;/sup&gt;</td>
<td>239</td>
<td>91.2</td>
<td>48.5</td>
<td>96.6</td>
<td>98.3</td>
<td>93.7</td>
<td>96.7</td>
<td>96.5</td>
<td>97.9</td>
<td>90.4</td>
<td>91.6</td>
<td>98.3</td>
<td>95.8</td>
<td>49.4</td>
<td>94.6</td>
<td>8.8</td>
</tr>
<tr>
<td>Enterococcus spp.</td>
<td>235</td>
<td>IR</td>
<td>95.7</td>
<td>96.5</td>
<td>78.3</td>
<td>IR</td>
<td>96.7</td>
<td>IR</td>
<td>77.0</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>88.1</td>
<td>IR</td>
<td>4.3</td>
<td></td>
</tr>
<tr>
<td>Streptococcus spp.</td>
<td>168</td>
<td>IR</td>
<td>99.4</td>
<td>99.4</td>
<td>98.2</td>
<td>88.6</td>
<td>97.0</td>
<td>98.2</td>
<td>92.2</td>
<td>94.6</td>
<td>52.4</td>
<td>IR</td>
<td>98.8</td>
<td>IR</td>
<td>98.2</td>
<td>4.2</td>
</tr>
<tr>
<td>P. aeruginosa</td>
<td>75</td>
<td>94.5</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>39.2</td>
<td>IR</td>
<td>90.5</td>
<td>IR</td>
<td>IR</td>
<td>0.0</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Includes S. aureus, S. pseudintermedius, and S. intermedius.

**Pasteurella spp.** Significant increased resistance trends to several antimicrobials were also observed in CPS; however, significant decreased resistance trends to trimethoprim-sulfamethoxazole and aminoglycosides were common among the isolates from dogs including CPS and Gram-negative bacteria.

**Discussion**

Empirical antimicrobial treatment is common in companion animal veterinary medicine. Knowledge of the most frequently isolated bacteria from cat and dog infections and their associated AMR patterns and trends are important considerations for successful therapy. This study provides information that can assist clinicians, especially those in Atlantic Canada, in making rational decisions on the use of antimicrobials. Samples submitted to the laboratory in this study may be a reflection of clinical cases of dogs and cats within this region. Clinical samples were commonly submitted from urinary tracts and ears in both cats and dogs, which may suggest urinary tract infections and otitis to be the major bacterial diseases of dogs and cats in Atlantic Canada. In both cats and dogs, *Staphylococcus* spp. was commonly isolated from several sample sources including skin, eyes, ears, surgical sites, wounds, and joints. This tissue distribution is unsurprising as *Staphylococcus* spp. are normal flora of various body sites, especially the integument and mucosa, and are known to cause clinical diseases such as pyoderma, and surgical site and wound infections in dogs (9). *Escherichia coli* was the dominant urinary bacterial isolate in this study, which is consistent with other reports from Canada (10) and the United States (11). Similar bacteria were isolated from both dogs and cats in this study, although the number of clinical samples was higher for dogs than for cats. *Escherichia coli* and *Staphylococcus* spp. were the most frequently isolated Gram-negative and Gram-positive isolates, respectively. These bacteria have been reported to be the most common isolates of dogs and cats (3,5).

In this study, *Staphylococcus* spp. isolates were classified based on a tube coagulate test. Coagulate-positive *Staphylococcus* spp. was isolated more often than coagulate negative *Staphylococcus* spp. in dogs; however, in cats, the opposite was true. High frequency of resistance to penicillin was observed in both CNS and CPS isolates from dogs; however, in cats, a high level of resistance was found only in CPS. Because of the widespread reduced susceptibility to penicillin and ampicillin, these 2 drugs are not indicated for the treatment of complicated staphylococcal infections in dogs and cats (12). This resistance phenotype is thought to be due to the dissemination of the gene for the narrow spectrum β-lactamase, βlaZ, and has been suggested as a major reason for penicillin resistance in *Staphylococcus* spp. in companion animals (12).

<table>
<thead>
<tr>
<th>Isolates</th>
<th>AMK</th>
<th>AMP</th>
<th>AMC</th>
<th>CHL</th>
<th>CLD</th>
<th>CEX</th>
<th>CEV</th>
<th>DOX</th>
<th>ERY</th>
<th>ENR</th>
<th>FUS</th>
<th>GM</th>
<th>PEN</th>
<th>TMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterooccus spp.</td>
<td>IR</td>
<td>1.12</td>
<td>1.30</td>
<td>1.09</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>1.00</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>1.01</td>
<td>IR</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>0.73</td>
<td>0.98</td>
<td>0.95</td>
<td>0.96</td>
<td>IR</td>
<td>0.88</td>
<td>0.95</td>
<td>1.03</td>
<td>IR</td>
<td>1.04</td>
<td>IR</td>
<td>0.80</td>
<td>IR</td>
<td>0.94</td>
</tr>
<tr>
<td>Pasteurella spp.</td>
<td>1.02</td>
<td>1.08</td>
<td>0.91</td>
<td>1.16</td>
<td>IR</td>
<td>0.85</td>
<td>1.23</td>
<td>0.97</td>
<td>1.10</td>
<td>IR</td>
<td>0.98</td>
<td>IR</td>
<td>0.98</td>
<td>1.05</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>0.98</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>1.07</td>
<td>IR</td>
<td>0.93</td>
<td>IR</td>
<td>0.93</td>
<td>IR</td>
<td>IR</td>
</tr>
<tr>
<td>Staphylococcus spp.</td>
<td>0.73</td>
<td>0.98</td>
<td>1.03</td>
<td>0.96</td>
<td>1.00</td>
<td>1.15</td>
<td>1.00</td>
<td>0.95</td>
<td>1.01</td>
<td>1.09</td>
<td>0.85</td>
<td>0.97</td>
<td>0.96</td>
<td>0.96</td>
</tr>
<tr>
<td>Staphylococcus spp.</td>
<td>0.88</td>
<td>1.05</td>
<td>1.15</td>
<td>0.98</td>
<td>1.06</td>
<td>0.58</td>
<td>1.04</td>
<td>0.99</td>
<td>1.05</td>
<td>0.96</td>
<td>0.95</td>
<td>0.95</td>
<td>0.93</td>
<td>0.93</td>
</tr>
<tr>
<td>Streptococcus spp.</td>
<td>IR</td>
<td>1.13</td>
<td>1.18</td>
<td>1.04</td>
<td>0.99</td>
<td>0.71</td>
<td>1.10</td>
<td>1.04</td>
<td>1.11</td>
<td>IR</td>
<td>0.96</td>
<td>0.93</td>
<td>0.96</td>
<td>0.93</td>
</tr>
</tbody>
</table>

AMK — amikacin; AMP — ampicillin; AMC — amoxicillin-clavulanate; CHL — chloramphenicol; CLD — clindamycin; CEX — cephalexin; CEV — ceftiofur; DOX — doxycycline; ERY — erythromycin; ENR — enrofloxacin; FUS — fusidic acid; GM — gentamicin; PEN — penicillin; TMS — trimethoprim-sulfamethoxazole; IR — intrinsic resistance.

* Includes S. aureus, S. pseudintermedius, and S. intermedius.

Bold — significant trends.
Table 4. Bacterial isolates from selected clinical samples from dogs submitted to the diagnostic laboratory (1994–2013).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>(95% CI)</td>
<td>(95% CI)</td>
<td>(95% CI)</td>
<td>(95% CI)</td>
</tr>
<tr>
<td>Urine</td>
<td>61 (6.1 to 10.9)</td>
<td>1.7 (1.4 to 2.0)</td>
<td>4.5 (4.0 to 5.0)</td>
<td>0.2 (0.0 to 0.4)</td>
</tr>
<tr>
<td>Skin</td>
<td>1 (1.1 to 1.2)</td>
<td>9.7 (6.2 to 12.4)</td>
<td>0.2 (0.1 to 0.3)</td>
<td>2.6 (1.8 to 3.4)</td>
</tr>
<tr>
<td>Female reproductive</td>
<td>6 (5.2 to 7.0)</td>
<td>3.8 (2.2 to 4.2)</td>
<td>0.8 (0.6 to 1.1)</td>
<td>2.7 (1.8 to 3.6)</td>
</tr>
<tr>
<td>Nasal cavity</td>
<td>7 (4.8 to 9.0)</td>
<td>7.0 (2.6 to 12.4)</td>
<td>0.3 (0.2 to 0.4)</td>
<td>1.3 (0.8 to 1.8)</td>
</tr>
<tr>
<td>Wound</td>
<td>7 (4.8 to 9.0)</td>
<td>1.1 (0.7 to 1.4)</td>
<td>0.2 (0.1 to 0.3)</td>
<td>0.4 (0.2 to 0.6)</td>
</tr>
<tr>
<td>Eyes</td>
<td>27 (22.7 to 31.1)</td>
<td>5.9 (2.8 to 8.4)</td>
<td>0.4 (0.3 to 0.6)</td>
<td>0.5 (0.3 to 0.7)</td>
</tr>
<tr>
<td>Surgical sample</td>
<td>12 (9.9 to 14.5)</td>
<td>5.2 (2.8 to 7.4)</td>
<td>0.3 (0.2 to 0.4)</td>
<td>1.1 (0.7 to 1.5)</td>
</tr>
<tr>
<td>Anal abscess</td>
<td>2 (1.5 to 2.8)</td>
<td>2.2 (1.2 to 3.3)</td>
<td>0.2 (0.1 to 0.3)</td>
<td>0.4 (0.2 to 0.6)</td>
</tr>
<tr>
<td>Joint</td>
<td>201 (194 to 208)</td>
<td>4.6 (2.1 to 8.6)</td>
<td>0.4 (0.3 to 0.6)</td>
<td>2.6 (1.8 to 3.4)</td>
</tr>
</tbody>
</table>

a Number of isolates; 95% CI — 95% confidence interval (exact method).

Among the CPS of dogs, MSCPS isolates were typically more susceptible to non-β-lactam antimicrobials compared to MRCPs. This comparison is well-established and consistent with other reports (13). Methicillin-susceptible coagulase-positive Staphylococcus spp. is known to be susceptible to most clinically relevant and available antimicrobials, except for penicillin and ampicillin (14). However, with the emergence of MRSP and the high occurrence of MDR in these strains, empirical selection of antimicrobials for treatment can be difficult. In the current study, MRCPs isolates were only predictably susceptible to amikacin and to fusidic acid, which is only for topical therapy. Thus, any infection not responding to initial antimicrobial therapy where CPS has a high likelihood of being present should have culture and sensitivity tests performed because of the high risk of MDR MRCPs being present (15). Of the CPS isolates from dogs over this study period, 4.5% were MRCPs, presumably MRSP. Most of the methicillin-resistant isolates were isolated within the last 5 y of the study, which coincides with the emergence of MRSP in this region. However, because of changes in CLSI standards in 2009 to oxacillin zone diameters and breakpoints for detecting methicillin-resistance in S. pseudintermedius isolates (16) and changes in routine laboratory procedures, it is likely that some CPS isolates from dogs before this time were misclassified as methicillin-susceptible.

Enterococcus spp. in this study were highly susceptible to several antimicrobials, including TMS, cephalexin, penicillin, ampicillin, clindamycin, and amoxicillin-clavulanate. This allows for several likely effective choices for empirical therapy. This susceptibility pattern of Enterococcus spp. has also been reported in Denmark (1). Enterococcus spp. susceptibility to enrofloxacin was low in both dogs and cats, with only 50% of the isolates susceptible. High MIC values have been documented for Enterococcus spp. and high frequency of resistance has been attributed by some to the common use of fluoroquinolone drugs in companion animal practice (17).

Enterococcus spp. is one of the causes of urinary tract infections in dogs and cats. Enterococci are MDR to many important classes of antimicrobials because of both intrinsic and acquired resistance (18). This limits antimicrobial options for empirical therapy for enterococcal infections. However, high proportions (87% to 97%) of enterococcal isolates were susceptible to penicillin, ampicillin, and amoxicillin-clavulanate, consistent with findings from Portugal (18). These proportions, however, are higher than those reported from the USA (19). Oral ampicillin or amoxicillin is commonly prescribed for first line therapy in cases of uncomplicated enterococcal urinary tract infections in dogs (20). Use of these antimicrobials as a first line treatment for empirical therapy in enterococcal infections is appropriate for this region. Combination therapy of ampicillin or amoxicillin with an aminoglycoside (e.g., gentamicin) results in synergistic bactericidal activity in susceptible enterococci and has been reported as a standard treatment option in complicated cases (21); however, this synergy test has not been routinely performed by this diagnostic laboratory.

Among the Gram-negative isolates in both dogs and cats, our results showed reduced susceptibility patterns to first generation cephalosporins (cephalexin) in E. coli and Proteus spp.
Staphylococcus spp., Pseudomonas spp., and Pasteurella spp. were highly susceptible to the β-lactams, consistent with our findings that Pasteurella spp. isolates had high susceptibility to many antimicrobials for this bacterium (28). Others have reported high susceptibility to enrofloxacin in this study may suggest that ampicillin-clavulanate was common in this study, yet increased resistance trends were found for Enterococcus spp., E. coli, Proteus spp., and CPS from dogs. A similar finding was reported for E. coli in community practices in the United Kingdom (5) and referral hospitals in Poland (7), while a non-significant trend in AMR was reported from Quebec, Canada (22). Enrofloxacin susceptibility in Pseudomonas spp. was low compared with a previous report from Quebec, Canada (22). Enrofloxacin is commonly used systemically with concurrent topical treatment in cases of canine otitis caused by P. aeruginosa (27). However, the high frequency of resistance to enrofloxacin in this study may suggest that aminoglycosides are a more appropriate first line antimicrobial to be used against infections due to Pseudomonas.

Doxycycline and amoxicillin-clavulanate are often used for the treatment of Pasteurella infections (28). Others have reported high susceptibility to many antimicrobials for this bacterium (1,29), consistent with our findings that Pasteurella spp. isolates were highly susceptible to the β-lactams, doxycycline, enrofloxacin, amoxicillin-clavulanate, and TMS. However, lower susceptibilities to erythromycin and the aminoglycosides in isolates from both dogs and cats were common.

Among the dog isolates, there was increased resistance to enrofloxacin over the study period for all listed bacteria except Pasteurella spp., while in cats, increased enrofloxacin resistance was only found in Streptococcus spp. Previous studies from Canada and the US have reported increased enrofloxacin resistance to CPS and E. coli (3,4). This increased resistance trend may be due to the widespread use of enrofloxacin in clinical practice.

Aminocillin-clavulanate is one of the most commonly prescribed antimicrobials for companion animals, especially in clinical cases with resistance to penicillin or third generation cephalosporins (30). High susceptibility to aminocillin-clavulanate was common in this study, yet increased resistance trends were found for Enterococcus spp., E. coli, Proteus spp., and CPS from dogs. A similar finding was reported for E. coli in community practices in the United Kingdom (5) and referral hospitals in Poland (7), while a non-significant trend in AMR was reported in the US (3). We also found an increased resistance trend to aminocillin-clavulanate in CPS, which is different from a previously published report from Canada (4) and the United Kingdom (5). Increased resistance trends in dog and cat bacterial isolates to enrofloxacin and aminocillin-clavulanate may be emerging and may need to be closely monitored, as both antimicrobials are of very high importance in human medicine (31). The use of these antimicrobials as a first line therapy should be avoided when possible.

Decreasing resistance trends to TMS and the aminoglycosides in both dog and cat isolates may reflect a general decline in the

Table 5. Antimicrobial susceptibilities in selected bacteria isolated from clinical samples of dogs (1994–2013).

<table>
<thead>
<tr>
<th>Isolates</th>
<th>n</th>
<th>AMK</th>
<th>AMP</th>
<th>AMC</th>
<th>CHL</th>
<th>CLD</th>
<th>CEX</th>
<th>CEV</th>
<th>DOX</th>
<th>ERY</th>
<th>ENR</th>
<th>FUS</th>
<th>GM</th>
<th>PEN</th>
<th>TMS</th>
<th>MDR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staphylococcus spp., M5 coagulase positive*</td>
<td>5024</td>
<td>92.4</td>
<td>31.4</td>
<td>99.4</td>
<td>98.6</td>
<td>91.5</td>
<td>98.7</td>
<td>94.7</td>
<td>92.7</td>
<td>90.7</td>
<td>95.2</td>
<td>98.0</td>
<td>97.1</td>
<td>31.3</td>
<td>81.5</td>
<td>13.7</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>3364</td>
<td>93.8</td>
<td>71.5</td>
<td>86.1</td>
<td>96.1</td>
<td>IR</td>
<td>57.1</td>
<td>91.2</td>
<td>86.6</td>
<td>IR</td>
<td>95.5</td>
<td>IR</td>
<td>94.5</td>
<td>IR</td>
<td>92.7</td>
<td>14.5</td>
</tr>
<tr>
<td>Streptococcus spp.</td>
<td>1846</td>
<td>IR</td>
<td>98.9</td>
<td>99.9</td>
<td>99.3</td>
<td>91.7</td>
<td>97.9</td>
<td>99.2</td>
<td>89.1</td>
<td>93.7</td>
<td>46.2</td>
<td>IR</td>
<td>IR</td>
<td>98.6</td>
<td>97.9</td>
<td>6.1</td>
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<tr>
<td>Proteus spp.</td>
<td>1526</td>
<td>89.1</td>
<td>IR</td>
<td>92.7</td>
<td>82.2</td>
<td>IR</td>
<td>51.1</td>
<td>93.5</td>
<td>IR</td>
<td>96.2</td>
<td>IR</td>
<td>88.9</td>
<td>IR</td>
<td>85.9</td>
<td>11.1</td>
<td></td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>1510</td>
<td>87.2</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>31.1</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>0.0</td>
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<tr>
<td>Enterococcus spp.</td>
<td>851</td>
<td>90.1</td>
<td>93.6</td>
<td>76.7</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>77.3</td>
<td>IR</td>
<td>IR</td>
<td>87.3</td>
<td>IR</td>
<td>5.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pasteurella spp.</td>
<td>623</td>
<td>67.4</td>
<td>99.4</td>
<td>99.5</td>
<td>99.0</td>
<td>IR</td>
<td>98.6</td>
<td>98.0</td>
<td>98.7</td>
<td>52.8</td>
<td>99.0</td>
<td>IR</td>
<td>82.8</td>
<td>98.6</td>
<td>99.0</td>
<td>2.6</td>
</tr>
<tr>
<td>Staphylococcus spp., coagulase negative</td>
<td>272</td>
<td>94.5</td>
<td>35.6</td>
<td>87.5</td>
<td>97.8</td>
<td>80.1</td>
<td>76.1</td>
<td>74.2</td>
<td>93.8</td>
<td>62.8</td>
<td>77.6</td>
<td>84.9</td>
<td>77.6</td>
<td>36.0</td>
<td>75.4</td>
<td>41.9</td>
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<tr>
<td>Staphylococcus spp., MR coagulase positive*</td>
<td>235</td>
<td>97.0</td>
<td>AR</td>
<td>AR</td>
<td>73.6</td>
<td>40.9</td>
<td>AR</td>
<td>66.8</td>
<td>33.6</td>
<td>42.9</td>
<td>96.2</td>
<td>53.6</td>
<td>AR</td>
<td>45.1</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

AMK — amikacin; AMP — ampicillin; AMC — amoxicillin-clavulanate; CHL — chloramphenicol; CLD — clindamycin; CEX — cephalaxin; CEV — cefovecin; DOX — doxycycline; ERY — erythromycin; ENR — enrofloxacin; FUS — fusidic acid; GM — gentamicin; PEN — penicillin; TMS — trimethoprim-sulfamethoxazole; MDR — multi-drug resistant; MS — methicillin-susceptible; MR — methicillin-resistant; IR — Intrinsic resistance; AR — Interpretive resistance to beta-lactam antimicrobials.

n — Number of isolates.

* Includes S. aureus, S. pseudintermedius, and S. intermedius.

This is similar to findings reported earlier in Canada (22) and in the US (3). Ampicillin is a common first choice drug in the treatment of E. coli associated urinary tract infections in both dogs and cats (23). The use of this antimicrobial for empirical treatment of E. coli infections should be considered with caution because of the rapid development of resistance caused by β-lactamase production (24). Other antimicrobials that were effective against E. coli and Proteus spp. for possible empirical selection include TMS, amikacin, and gentamicin. Pseudomonas spp. are intrinsically resistant to most antimicrobials because of the inability of most antimicrobials to penetrate the cell membrane of the bacterium (4). Pseudomonas is considered to be intrinsically resistant to β-lactams, combinations with β-lactamase inhibitors, chloramphenicol, erythromycin, and TMS. In this study, high proportions of Pseudomonas were susceptible to the aminoglycosides suggesting that this antimicrobial class is still effective as anti-pseudomonal drugs (25). Our findings are also consistent with similar retrospective studies from Denmark and the US (1,26). Enrofloxacin susceptibility in Pseudomonas spp. was low compared with a previous report from Quebec, Canada (22). Enrofloxacin is commonly used systemically with concurrent topical treatment in cases of canine otitis caused by P. aeruginosa (27). However, the high frequency of resistance to enrofloxacin in this study may suggest that aminoglycosides are a more appropriate first line antimicrobial to be used against infections due to Pseudomonas.
### Table 6. Antimicrobial resistance trends in selected bacteria isolated from clinical samples of dogs (1994–2013).

<table>
<thead>
<tr>
<th>Isolates</th>
<th>AMK</th>
<th>AMP</th>
<th>AMC</th>
<th>CHL</th>
<th>CLD</th>
<th>CEX</th>
<th>CEV</th>
<th>DOX</th>
<th>ERY</th>
<th>ENR</th>
<th>FUS</th>
<th>GM</th>
<th>PEN</th>
<th>TMS</th>
<th>Odds ratio (P-values)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Enterococcus spp.</strong></td>
<td>IR</td>
<td>0.99</td>
<td>1.07</td>
<td>1.08</td>
<td>IR</td>
<td>IR</td>
<td>1.03</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>1.0</td>
<td>IR</td>
<td>(0.888) (0.001)</td>
</tr>
<tr>
<td><strong>E. coli</strong></td>
<td>0.75</td>
<td>1.02</td>
<td>1.03</td>
<td>0.98</td>
<td>IR</td>
<td>0.93</td>
<td>1.10</td>
<td>IR</td>
<td>1.04</td>
<td>IR</td>
<td>1.10</td>
<td>IR</td>
<td>0.88</td>
<td>IR</td>
<td>(0.846) (0.001)</td>
</tr>
<tr>
<td><strong>Pasteurella spp.</strong></td>
<td>0.96</td>
<td>0.86</td>
<td>1.02</td>
<td>1.05</td>
<td>IR</td>
<td>0.99</td>
<td>1.34</td>
<td>IR</td>
<td>1.06</td>
<td>1.15</td>
<td>IR</td>
<td>1.15</td>
<td>IR</td>
<td>0.53</td>
<td>(0.002) (0.001)</td>
</tr>
<tr>
<td><strong>Proteus spp.</strong></td>
<td>0.74</td>
<td>IR</td>
<td>1.06</td>
<td>0.99</td>
<td>IR</td>
<td>0.99</td>
<td>1.21</td>
<td>IR</td>
<td>1.08</td>
<td>IR</td>
<td>0.91</td>
<td>IR</td>
<td>0.95</td>
<td>IR</td>
<td>(0.001)</td>
</tr>
<tr>
<td><strong>Pseudomonas aeruginosa</strong></td>
<td>0.98</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>1.18</td>
<td>IR</td>
<td>0.96</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>(0.002)</td>
</tr>
<tr>
<td><strong>Staphylococcus spp.</strong>,</td>
<td>0.98</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>1.18</td>
<td>IR</td>
<td>0.96</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>IR</td>
<td>(0.002)</td>
</tr>
<tr>
<td>coagulase negative</td>
<td>(0.644)</td>
<td>(0.086)</td>
<td>1.04</td>
<td>0.83</td>
<td>1.04</td>
<td>1.08</td>
<td>1.48</td>
<td>1.00</td>
<td>1.03</td>
<td>1.11</td>
<td>1.09</td>
<td>0.97</td>
<td>1.05</td>
<td>1.01</td>
<td>(0.001) (0.002)</td>
</tr>
<tr>
<td><strong>Staphylococcus spp.</strong></td>
<td>0.75</td>
<td>1.00</td>
<td>1.54</td>
<td>1.22</td>
<td>1.01</td>
<td>1.27</td>
<td>1.75</td>
<td>1.11</td>
<td>1.04</td>
<td>1.19</td>
<td>1.02</td>
<td>1.15</td>
<td>1.00</td>
<td>0.91</td>
<td>0.01</td>
</tr>
<tr>
<td>coagulase positive*</td>
<td>(0.001)</td>
<td>1.00</td>
<td>1.54</td>
<td>1.22</td>
<td>1.01</td>
<td>1.27</td>
<td>1.75</td>
<td>1.11</td>
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<td>0.91</td>
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<td><strong>Streptococcus spp.</strong></td>
<td>0.94</td>
<td>IR</td>
<td>1.05</td>
<td>0.92</td>
<td>0.97</td>
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<td>1.53</td>
<td>1.01</td>
<td>1.04</td>
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<td>IR</td>
<td>IR</td>
<td>0.93</td>
<td>0.90</td>
<td>(0.061) (0.001)</td>
</tr>
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AMK — amikacin; AMP — ampicillin; AMC — amoxicillin-clavulanate; CHL — chloramphenicol; CLD — clindamycin; CEX — cephalexin; CEV — cefovecin; DOX — doxycycline; ERY — erythromycin; ENR — enrofloxacin; FUS — fusidic acid; GM — gentamicin; PEN — penicillin; TMS — trimethoprim-sulfamethoxazole; IR — Intrinsic resistance.

* Includes S. aureus, S. pseudintermedius, and S. intermedius.

Bold — significant trend.
use of these drugs over the past decades. Their use has been replaced by newer and broader spectrum antimicrobials such as the cephalosporins, fluoroquinolones, amoxicillin-clavulanate, and doxycycline (2). In general, resistance trends in both dog and cat isolates may reflect the changing patterns of antimicrobial use over the study time. The antimicrobials that showed increasing resistance trends with a high proportion of susceptible isolates should be monitored closely in the future. Antimicrobial resistance may exist in a bacterial population before it is detected in 1% of clinical samples submitted to the laboratory, but this may be followed by a rapidly increasing resistance rate (5).

Multi-drug resistance was higher in dogs than in cats, suggesting that dogs may be a major source of MDR among companion animals. Others have suggested that this may be due to the differences and variations in the antimicrobial prescribing or therapeutic use patterns in dogs and cats (5). In dogs, similar to a previous report (32), the prevalence of MDR (13.7%) was much lower in MSCPS compared with 100% MDR in MRCPS. All the MRCPS isolates in dogs, almost all of which were MRS, were considered resistant to all β-lactams, including amoxicillin-clavulanate using the interpretive criteria, but were also resistant to at least 2 non-β-lactam drug classes. In a multicenter study involving both North America and Europe (33) and a recent study from Atlantic Canada (34), all MRSP were MDR and also showed lower frequency of susceptibility to several other antimicrobial classes including tetracyclines, macrolides, fluoroquinolones, lincosamides, phenicols, and potentiated sulfonamides. This MDR characteristic can pose a major challenge for antimicrobial therapy in companion animal medicine, because of the limited available treatment options in cases of MRSP infections.

The Kirby-Bauer disk diffusion antimicrobial susceptibility testing method was used over the study period. This makes a comparison with other studies that used micro-broth dilution methods challenging. Extrapolation of our data to other parts of the world should also be done with caution, as there are geographical variations in susceptibility among isolates. Additionally, changes in the zone diameters and breakpoints for susceptibility over the years may also have resulted in some classification bias, such as the situation with methicillin resistance in canine staphylococci. Use of retrospective susceptibility data from clinical submissions provides some insight, even though there is bias in these data. Specifically, use of isolates from referral diagnostic laboratory submissions may be overly pessimistic regarding the susceptibility of bacterial isolates, as these cultures are often from patients in which there has been treatment failure with the initial empirical therapy. Previous studies found that AMR is higher in isolates submitted from community veterinary practices to reference diagnostic laboratories for culture and susceptibility testing, as the animals were likely to have received antimicrobial therapy in the days preceding culture (35). Also, some of the isolates in this study may be part of the normal microflora or contamination and not necessarily the pathogenic organism causing clinical disease. However, the veterinary clinical bacteriologist reviews the culture results and avoids performing sensitivity testing on non-diagnostic samples, unless specially requested by the submitting clinician. It should also be noted that more than 1 clinical sample and recovered organism may have originated from the same dog or cat because of repeated culture sampling by the clinician. Low frequencies observed for some bacterial-antimicrobial combinations may have resulted in lack of statistical power to detect a significant change in prevalence of antimicrobial resistance over time. Similarly, change in zone diameters for bacterial-antimicrobial combination over time, may have resulted in misclassification of certain bacteria as susceptible or resistance. This bias may also have resulted in lack of power for a significant change in resistance over time.

This study has provided information on susceptibility patterns in major cat and dog bacterial isolates from Atlantic Canada. Information on antimicrobial susceptibilities and resistance trends reported in this study can be used for practice-based and regional guidelines for the rational use of antimicrobials in Atlantic Canada. This information together with sound clinical judgment can be used as a guide for the empirical treatment of companion animals while waiting for susceptibility testing or when it is not feasible.

Acknowledgment

Thanks to Robert Page of the University of Prince Edward Island for his help in the retrieval of the culture and susceptibility data from the database.

References


Book Review

Animal Restraint for Veterinary Professionals, 2nd edition


The 2nd edition of Animal Restraint for Veterinary Professionals is a very useful book for anyone working in the veterinary field, whether they are new to it, or very experienced. It starts off by mentioning that the animals we work with need to be shown respect and compassion, and why good restraint technique is very important to ensure the safety of these animals, as well as ourselves. It offers information on restraint and safety precautions for a wide variety of species including, but not limited to, ferrets, birds, cats, swine, and horses. This makes it an ideal book for any veterinary establishment to have on hand.

Each chapter explains in detail how restraints are to be done to ensure that they are done properly. It also shows what to look out for and what to avoid when handling certain animals. Firm but humane restraint is taught, to the ensure safety of the animal as well as the handler. An incredible amount of full color images are included to add to the descriptions and aid the reader in understanding the technique. This is especially important for a visual learner or those who may have not seen a certain species before. Various restraint techniques are shown for different procedures, such as radiographs and administration of different kinds of medication.

The book also explains specific restraint tips for aid in restraining young animals. A section explaining how to tie different types of knots is included, which is beneficial for animal restraint and other uses.

Personally, I have actually used some of the techniques shown in this book in practice, and can confirm that they do work very well. I would absolutely recommend this book to anyone who works in the veterinary field and wants to have a better understanding of how to work with the animals in a safe and humane way.

Reviewed by Shannon Wheatley, RVT, Ottawa, Ontario.
Laparoscopic-assisted ovariohysterectomy for the treatment of pyometra in a Bengal tiger (*Panthera tigris tigris*)

Blair Rainey, Ameet Singh, Alexander Valverde, Katie Hoddinott, Hugues Beafrère, Laura Tindal, Dale Smith

**Abstract** — A laparoscopic-assisted ovariohysterectomy was performed in a 19-year-old intact, female Bengal tiger (*Panthera tigris tigris*) presented for surgical treatment of pyometra. A multi-port technique was used with intracorporeal sealing of the ovarian pedicles and extra-corporeal ligation of the uterine vessels and body. The tiger recovered from surgery and anesthesia without complication, was released into its enclosure the same day, and has remained clinically normal. Laparoscopic-assisted ovariohysterectomy may have advantages over open ovariohysterectomy for treatment of pyometra in the tiger.

Pyometra is a common disorder of intact domestic canines and, to a lesser extent, felines (1–4). This condition also occurs in large, exotic, captive felids such as tigers and lions, with various reports indicating a prevalence between 5.5% and 17%, with lions possibly having an increased prevalence (2,5,6). Pyometra in companion animals and large, exotic felids occurs when there is cystic endometrial hyperplasia due to the effect of progesterone on the superficial epithelium and endometrial glands of the uterus (1,3,4,7,8).

Pyometra primarily impacts large, exotic felids that are more than 10 y of age (2,5–7). The presence of cystic endometrial hyperplasia and pyometra is complicated in large, exotic felids in captivity by the interplay between the age of the animal and the use of contraceptive implants (2,5–7). Melengesterol acetate (MGA) is a progestin that has been commonly used as a contraceptive implant in large, exotic felids in captivity (2,5–7,9). It is an effective and cost-efficient method of contraception, and most importantly is reversible if it is decided that the animal is genetically valuable (6). However, there is some evidence suggesting that it may increase the prevalence of cystic endometrial hyperplasia, and thereby predispose animals to pyometra (2,6,7).

Current standard of care for the treatment of open and closed pyometra in non-breeding companion animals is ovariohysterectomy (OVH) via laparotomy (3,10–12). There has been a movement towards the use of minimally invasive surgery in veterinary medicine as it provides improved visualization of internal structures, reduced incision size and subsequent reduction in soft tissue trauma, reduced postoperative pain, and possible reduction in prevalence of infection associated with the surgical site (9–11,13–16). Recently, the use of single- (11) and multi-port (10) techniques for laparoscopic-assisted ovariohysterectomy (LAOVH) has been described for pyometra in dogs (10,11).

Laparoscopic surgery has previously been reported in large, exotic felids. Multi-port laparoscopic-assisted ovariohysterectomy (LAOVH) in lions was first described by Aguilar et al in 1997 (17) and then Kolata in 2002 (18). Recent reports described single- and multi-port laparoscopic ovariohysterectomy (LOE) in tigers (13,16), lions (19), and cheetahs (19). Laparoscopic salpingectomy (LS) has also been described in lions, leopards, and cheetahs (9,19). Laparoscopic-assisted ovariohysterectomy for the treatment of pyometra in a large, exotic felid has not previously been described. The purpose of this
report is to describe the technique of LAOVH for the treatment of pyometra in an adult Bengal tiger (*Panthera tigris tigris*).

**Case description**

A 19-year-old, intact female, Bengal tiger (*Panthera tigris tigris*) residing in a privately owned animal sanctuary was presented to the Ontario Veterinary College Health Sciences Centre (OVCHSC) for surgical treatment of an open pyometra. The tiger had a 10-day history of decreased appetite, lethargy, and sanguinopurulent vulvar discharge and was not receiving contraceptives. Cytological evaluation of the vaginal discharge performed by the primary veterinarian revealed the presence of degenerative neutrophils and rod-shaped bacteria. Bacterial culture of the sample isolated *Escherichia coli*, which was susceptible to a variety of antimicrobials. Given the history, signalment, and clinical signs, an open pyometra was diagnosed. The tiger was sedated and blood samples were obtained for complete blood (cell) count (CBC), and serum biochemistry. The results were mostly unremarkable, with a mild neutrophilia of $12.97 \times 10^9$/L [reference interval (RI): 2.5 to 12.6 $\times 10^9$/L]. One week before presentation, the tiger had received trimethoprim/sulphonamide (Tibrisson 48%; Merck Animal Health, Kirkland, Quebec), 30 mg/kg body weight (BW), IM, and procaine penicillin G (Pen Aqueous; Zoetics Canada, Kirkland, Quebec), 15 mg/kg BW, IM, and meloxicam (Metacam; Boehringer Ingelheim, Burlington, Ontario), 0.1 mg/kg BW, PO, q24h for 3 d. Two days later enrofloxacin (Baytril; Bayer, Toronto, Ontario), 5 mg/kg BW, PO, q24h, was commenced as no improvement in clinical signs had been noted. Seven days following initiation of antimicrobial therapy, the tiger was sedated and administered a second IM injection of procaine penicillin G and trimethoprim/sulphonamide at the same dose as initially administered, as well as 3 L of isotonic saline and 1 L of Lactated Ringer’s solution subcutaneously. Because of a lack of improvement in clinical signs, the tiger was referred to the OVCHSC for an ovariohysterectomy for treatment of the pyometra.

Upon presentation to the OVCHSC, the tiger was quiet, but alert and responsive with a body condition score of 4/9. Body weight was estimated at 150 kg. Visual examination revealed a hemorrhagic discharge from the vulva and normal respiratory rate. Thoracic auscultation and abdominal palpation were not performed prior to sedation.

The tiger was sedated with xylazine (Bayer, Mississauga, Ontario), 0.7 mg/kg BW, IM, ketamine (Bioniche Animal Health, Belleville, Ontario), 2.7 mg/kg BW, IM, and midazolam (Sandoz, Boucherville, Quebec), 0.07 mg/kg BW, IM, administered by a single manual injection. Once heavy sedation was achieved, endotracheal intubation was conducted; anesthesia was maintained with isoflurane (Baxter, Mississauga, Ontario) in oxygen with mechanical ventilation. Physical examination revealed pale pink mucous membranes and the tiger was estimated to be 7% dehydrated. Abdominal palpation was challenging due to the size of the animal. Once the tiger was intubated a partial dose of atipamezole (Antisedan; Zoetics Canada), 0.05 mg/kg BW, IM, was given due to bradycardia. An IV catheter was placed in the lingual vein through which the tiger received Lactated Ringer’s Solution (Baxter), 10 mL/kg BW per hour throughout the procedure. A catheter was placed in the right metatarsal artery to allow direct blood pressure monitoring. Esophageal temperature, end-tidal carbon dioxide, and electrocardiography were all used for intraoperative monitoring. Hydromorphone (Knoll Pharma, Markham, Ontario), 0.03 mg/kg BW, IV, was given for intraoperative analgesia. In addition, ampicillin (Hanford Pharmaceuticals, Syracuse, New York, USA), 23.3 mg/kg BW, and enrofloxacin (Baytril; Bayer), 1 mg/kg BW, were also given IV before surgery.

The patient was placed in dorsal recumbency and the ventral abdomen was aseptically prepared for surgery. A 3-cm incision was made mid-way between the umbilicus and the pubis and a single incision, multi-cannulated port (SILS port; Medtronic/Covidien, Minneapolis, Minnesota, USA) was introduced (11). Two 5-mm cannulas and one 15-mm cannula were inserted through the single port. The abdomen was insufflated with carbon dioxide to 10 mmHg using a mechanically regulated insufflator (Endoflator; Karl Storz Veterinary Endoscopy, Goleta, California, USA) and a 10-mm, 30°, 31-cm laparoscope (Hopkins II 0° and 30° 10-mm, 31-cm Telescope; Karl Storz Veterinary Endoscopy) was introduced into the abdomen through the 15-mm cannula. Both the left and right uterine horns were markedly distended and manipulation of the uterus through the single port was performed but found to be challenging because of the large size and weight of the uterus. A 10-mm instrument portal was thus placed at the level of the umbilicus on the ventral midline (Figure 1). The patient was tilted 45° laterally from dorsal to expose the left ovary and its pedicle and 5-mm laparoscopic Babcock forceps (Clickline, 5 mm, Straight Babcock Forceps; Karl Storz Veterinary Endoscopy) were introduced through the single port and used to grasp and elevate the proper ligament. A vessel-sealing device (Ligasure, 10 mm; Covidien, Mansfield, Massachusetts, USA) was used to seal and divide the ovarian pedicle and the broad ligament. The tiger was tilted to the opposite side and the procedure was repeated to seal and divide the right ovarian pedicle. The instruments and laparoscopic ports were removed from the abdomen and the carbon dioxide was purged. To successfully remove the uterus without its rupture the 2 port incisions were connected resulting in an approximately 15-cm incision. Because of the size of the uterus, it could not be removed through this incision and, therefore, it was extended another 10 cm caudally. The uterus was exteriorized, and the uterine vessels were sealed and divided with the vessel-sealing device (Figure 2). The uterine body was double ligated with #2 PDS (Polydioxanone; Johnson and Johnson, Markham, Ontario), using a circumferential and transfixing ligature. The abdomen was copiously lavaged with warm physiologic saline and closed routinely in 3 layers without external skin sutures. To provide additional perioperative analgesia, incisional infiltration of bupivacaine (Hospira, Lake Forest, Illinois, USA), 0.07 mg/kg BW, was performed in the rectus abdominus fascia at the time of closure of the linea alba. Histopathological evaluation and bacterial culture of the uterus were declined for financial reasons.

Total surgical time was 150 min. A second dose of hydromorphone of 0.03 mg/kg BW, IV, was administered before recovery.
and a second dose of atipamezole of 0.05 mg/kg BW, IM, was used for complete reversal of the xylazine sedation before extubation. The tiger recovered from anesthesia in the transport cage without complication and was alert and responsive 60 min after surgery. The tiger was returned to the sanctuary upon recovery from anesthesia. Her keepers reported that she was comfortable and mobile within her enclosure and that she was eating the following day after surgery. At time of telephone follow-up 574 d after surgery, the tiger was clinically normal.

Discussion

While laparoscopic surgery has previously been reported in large, exotic felids for various sterilization procedures, to our knowledge this is the first report describing LAOVH for the treatment of pyometra in a Bengal tiger. Perioperative complications were not encountered, aside from the need to extend the access incision larger than anticipated based on the massive distension of the uterine horns. A previous study of open OVH for pyometra in large exotic felids had reported an incision length between 12 cm and 20 cm depending on size of the animal (13). Despite extension of the surgical incision to ~25 cm, the authors believe the size of the incision was considerably reduced compared to what would have been necessary if a full exploratory laparotomy had been performed as the ovarian pedicles were sealed intracorporeally with laparoscopic techniques. The surgical time for the LAOVH was similar to previously reported times for ovariohysterectomy for pyometra in tigers via open surgery (2).

Pyometra is uncommonly reported in large, exotic felids (2,5,7,20). Interestingly, the systemic effects seen in these species appears to be much less severe than in the bitch, with lethargy and fever being the primary signs reported, as well as vomiting and anorexia less commonly (2,7). Identification of pyometra in these animals is based primarily on visualizing mucopurulent or mucohemorrhagic vulvar discharge suggesting that most pyometras diagnosed in large, exotic felids are open, with closed pyometra likely being underdiagnosed (2,7). Only 1 report of closed pyometra in a large, exotic felid (leopard) exists, which resulted in septic peritonitis from uterine rupture and was identified postmortem (20). Caretakers of large, exotic felids may experience difficulty in diagnosing a closed pyometra, as lethargy followed by vaginal discharge, may be the only clinical signs witnessed. This is further complicated by the fact that large, exotic felids in captivity are not in regular close contact with their handlers making detection of subtle changes that may occur with this disease harder to identify. The tiger in this report had lethargy and vaginal discharge and she was intact; pyometra was

Figure 1. Intra-operative image showing placement of the portal during LAOVH. A single incision, multi-channeled port has been placed in a subumbilical location and a 10-mm port has been placed 10 cm cranial to this port. All portals are inserted in the ventral midline.

Figure 2. Intra-operative image showing exteriorization of the uterus through the mini-laparotomy.
assumed. Like their domestic counterparts, large, exotic felids typically have *E. coli* and less commonly *Pseudomonas aeruginosa* identified as the primary pathogen in pyometra (2,5,7,20). The tiger in this report had *E. coli* identified via bacterial culture of the vaginal discharge.

The use of LAOVH in treating pyometra via single-port (11) and multi-port techniques (10) has been explored in dogs, and found to be successful in treating both open and closed pyometras (10,11). These studies established a guideline that LAOVH should be used in cases in which the uterine horn diameter was no larger than 4 cm (10,11). This guideline is difficult to extrapolate to large, exotic felids; however, had diagnostic imaging been performed preoperatively, a minimally invasive approach may not have been attempted based on the marked dilation of uterine horns with purulent material. However, the reduction in incision size which resulted from LAOVH was desirable in the tiger of this case as incisional complications are difficult to assess and treat in large, exotic felids.

Laparoscopic-assisted ovariohysterectomy was initially attempted in this case using a single port approach. However, based on the marked distention of uterine horns from pyometra a second portal was quickly established to help with careful manipulation. Single-port LOE has been reported in tigers with good success (16); however, this platform has not been described for routine OVH or OVH for pyometra. The authors believe that if uterine distention had been mild, single-port LAOVH could have been performed as described by Wallace et al (11) in dogs. Based on sheer size of the animal, it would be unlikely that the uterus, even with mild uterine distention, could have been extracted through the ~3 cm single-port access incision. Furthermore, placing a second instrument port to help with manipulation of pertinent structures and relieve the loss of triangulation that occurs with single-port platforms would not result in greater soft tissue trauma since the 2 portal incisions can be connected to allow for uterine extraction. This was the strategy performed in the tiger of this report and we recommend a multi-port approach for LAOVH in tigers and other large, exotic felids for routine OVH or OVH for pyometra.

The use of LOE and LS in groups of free-roaming large, exotic felids has been well-described by Hartman et al. (9,19). This research group found that the benefits of shorter surgical times and decreased incision size make laparoscopic techniques extremely valuable in populations of free-roaming large felids in conservation and game farms in Africa (19). Generally, when groups of free-roaming animals are to be sterilized, they are captured as a group and remain together following recovery from anesthesia (19). This strategy is used to prevent aggression towards group members following reintroduction of individuals, a challenging situation that can also occur in captivity when groupmates are reintroduced following separation (13,19). The tiger of this report did have several groupmates at the sanctuary where she resided, and was returned to them the same day of surgery without complication. The use of laparoscopic-assisted techniques for OVH may have reduced post-operative pain and allowed for a more rapid reintegration with her groupmates compared to an open OVH.

In summary, to our knowledge, this is the first reported case of LAOVH for the treatment of pyometra in a Bengal tiger (*Panthera tigris tigris*). The surgical technique was performed without complication despite markedly distended uterine horns secondary to pyometra which resulted in a larger access incision. Recovery was uneventful, and the tiger continued to do well 574 d after surgery. Laparoscopic-assisted ovariohysterectomy should be considered for the treatment of pyometra in large exotic felids in captivity.

References

Modernizing Canada’s foot and mouth disease response plan

Murray Gillies

Canada has been fortunate to remain free of foot and mouth disease (FMD) since the 1950’s, despite the huge increase in global travel and the evolution of the virus over the years. Despite Canada’s FMD-free status, and the relatively low risk of an outbreak, FMD remains a critically important disease for Canada’s federal, provincial, and livestock industry sectors. It is estimated that an FMD outbreak in Canada would cost approximately 65 billion dollars in losses and affect not just the livestock industry but also Canada’s grain industry, veterinary sector, and tourism industry. An outbreak would also have a substantial impact on the mental health of everyone involved in its eradication, particularly veterinarians and animal producers, and would leave a negative impression in the eyes of the public.

With recent changes to animal production and the success of vaccine strategies, as well as current pressures on the World Organization for Animal Health (OIE) to change the way it classifies FMD status for countries, it is timely for Canada to consider modernizing its FMD response in order to have a more complete and all-encompassing national strategy.

The OIE is recognized by the World Trade Organization (WTO) as the relevant body to develop and publish health standards for the international trade in animals and animal products (1,2). Under the WTO agreement on Sanitary and Phytosanitary (SPS) measures, countries agree to base their SPS standards on science, and to be guided by the SPS measures in their actions. The 181-member countries have agreed to base their import and export requirements on the OIE standards and to not use their SPS measures to arbitrarily or unjustifiably discriminate against other members nor to use them to disguise trade restrictions. Ultimately, the OIE is responsible for classification of a country’s FMD status and therefore plays a major role in determining that country’s ability to export. Canada is considered to be free of FMD without vaccination but the threat of an FMD outbreak is not to be taken lightly.

Although the CFIA’s website declares that Canada would be ready to act quickly and efficiently in the event of an FMD outbreak, the CFIA has been encouraging stakeholders to engage with the CFIA to develop a new, collaborative plan utilizing vaccination in certain situations. The previous response plan of utilizing only movement controls and stamping out focused on smaller farms and processors and is no longer appropriate for today’s swine and cattle industries. Increasing herd size and processor consolidation have made previous plans no longer applicable to all situations. The group of industry and government personnel who attended a recent tour of an FMD vaccine manufacturing facility in Lyon, France, supports the CFIA position that further work is needed in the near future to better position Canada to respond to an FMD outbreak.

Many issues identified by the Lyon group of industry and government representatives will require this cooperative approach between federal and provincial governments and stakeholders. These issues need to be discussed and plans formulated in detail based on regional differences and multiple scenarios, with the assistance of modelling and exercises. For example, an outbreak in the Maritimes or Newfoundland could likely be controlled effectively through biosecurity, movement controls, and stamping out, resulting in a fairly small outbreak with the least impact on the country’s overall food animal production. However, an outbreak in the middle of Quebec or Ontario would likely warrant a completely different approach, perhaps including vaccination, and could have a much larger impact on the livestock sector in Canada. The worst-case scenario with a devastating impact on the livestock sector in Canada would be if an outbreak were to occur in the very dense animal population in Alberta, in which case early use of vaccination would need to be included in any control measures. Detailed response plans need to be developed and agreed to by all parties ahead of time in order to mitigate the harmful effects an FMD outbreak would have on Canada’s livestock sector. These plans then need to be modelled and practiced through exercises so that we are better able to deal with an outbreak.

Canada also needs to develop plans to deal with an outbreak that might occur in the US. This possible situation was recently discussed at a February meeting of the Livestock Market Interruption Strategy, an initiative of Agriculture and Agri-Food Canada (A AFC). The 2 countries’ animal agriculture industries are so interlinked that an outbreak in the US would have a great effect on Canada’s ability to import products from and export products to the United States, our largest trading partner. This would also present a major welfare issue to the Canadian livestock industries since 70% of all swine produced in Canada and

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Dr. Gillies was the CVMA and CABV representative on the Boehringer-Ingelheim foot and mouth antigen storage bank tour in Lyon, France.

This report was made possible through extensive collaboration with veterinarians from the Canadian Food Inspection Agency. Address all correspondence to Dr. Murray Gillies: e-mail: mgilliesdvm@gmail.com

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50% of Canadian beef are exported. Terry Whiting (3) indicates that we would have to begin humane slaughter in the swine industry within 3 days of a border closure.

One specific issue identified that needs to be addressed collectively by all stakeholders is that the CFIA does not have the authority to impose a 72-hour movement standstill under the Health of Animals Act during the time that initial cases are being investigated and traced in order to determine the extent of the spread. Once the extent has been determined the Minister can declare a Primary Control Zone after which all movements of animals and fomites in the zone that are capable of spreading the virus would require permits. One option could be a provincial or industry mandated 72-hour (or greater) standstill in order to allow the time necessary to determine the extent of an FMD outbreak. However, even with this 72-hour standstill, American modelling has shown difficulty in controlling the spread due to a lack of personnel able to be deployed into the field.

A second issue that needs to be addressed is having rapid access to a robust, centralized traceability system that would allow faster regionalization of the outbreak. Canada’s traceability system is inadequate to provide this rapid response, especially across all FMD susceptible species and for animals moving through 1 or more intermediate sites such as assembly yards or auction markets. While most of these sites maintain good records, they are often not linked to a centralized data center, making it laborious to identify and trace all contact animals. Fortunately, many industry organizations, such as the Dairy Farmers of Canada’s ProAction initiative, have greatly enhanced our traceability capabilities, but further work is needed.

The final issue identified by the stakeholder group is funding for Canada’s preparedness and response activities. Preparing for and dealing with an FMD outbreak requires considerable financial and human resources. Government organizations contribute a fair portion to these requirements, but it is insufficient. Federal and provincial governments, and key stakeholders, must be committed to continuous base program funding to ensure that Canada is prepared. Financial contributions to an antigen bank without having a detailed action plan in place is not the best use of resources. Arrangements also need to be made with slaughter facilities that could be used in the event of an outbreak. There would have to be some agreement in place with compensation to the slaughter facilities to pay employees who perform welfare slaughter or depopulation activities in which there is no financial benefit to the slaughter company. Currently, the CFIA, under the Health of Animals Act, can only offer compensation for animals that they order destroyed, not healthy animals whose value is impacted by a disease response. Agriculture and Agri-Food Canada may be able to help develop and fund market interruption and income stability programs, but all players need to discuss these issues as soon as possible. Focusing on these issues would help contribute to an overall plan for control and eradication and would be a good use of our time while we await changes to the OIE standards.

Since an outbreak of FMD in one area of the country (without emergency zoning, which the OIE does not allow) would affect the entire country’s trading status on the world market and especially with the US, a nationwide approach to surveillance, disease control and eradication is essential. Regional differences would exist in response plans but would all be based on a stamping out approach with or without vaccination, combined with disease control zoning, rapid movement restrictions, and traceability.

Modelling has shown that large outbreaks can be mitigated by vaccination. Estimates predict that the early use of vaccination in large-scale outbreaks can reduce the duration and the number of premises affected by half. Most FMD experts agree that depopulating infected animals within 24 to 48 hours after diagnosis is the most effective method of reducing the virus’ aerosol spread. However, the labor and logistics that would be required to depopulate a 40 000 cow FMD-infected feedlot, for example, makes that 48-hour target impractical. In fact, studies have suggested that the timeframe required to do this is at least 78 days! It would be much more efficient and effective to have farm personnel initiate FMD vaccination of these animals through their chute systems, quarantine them on the premises, and deal with them at a later date. This is effective in that vaccination reduces viral shedding, limits transmission, and lets animals recover, allowing for delayed depopulation.

The purpose of our stakeholder and government group’s trip was to visit the North American FMD Vaccine Bank storage location at the Boehringer-Ingelheim (formerly Merial) vaccine plant on the outskirts of Lyon, France. Following the tour, Boehringer-Ingelheim’s technical and sales team gave us an update on the epidemiology of FMD as well as recent successful uses of a vaccine strategy to control and even eradicate FMD in Japan, South Korea, and Uruguay. These examples show that effective control and a return to free status is possible even when utilizing vaccination. Canada is primarily an exporting country and the use of vaccination would limit our ability to trade until we returned to an FMD-free without vaccination status. The CFIA’s recommendation is that any decision to vaccinate be taken from a disease control standpoint and needs to be separated from the decision on how to deal with the uninfected vaccinates after the FMD outbreak is under control and Canada is working on returning to country freedom status (4,5). Vaccination has been successful in other countries in controlling the disease and minimizing loss, which makes vaccination a more attractive option than it had previously been. The fact that Canada could have an antigen-specific vaccine within 5 days of activating our bank could prove to be very useful in controlling a moderate to large-scale outbreak or an outbreak in a region with a high density of animals.

The OIE currently treats countries that stamp out all vaccinated animals differently from those that allow their vaccinates to live. Countries that stamp out all vaccinated animals are said to be pursuing a “vaccinate-to-kill” policy (6,7). Countries that want to allow vaccinated animals to live out their useful lifespan after an outbreak are said to be pursuing a “vaccinate-to-live” policy. The latter is CFIA’s preference, and if a vaccinate-to-live strategy in Canada is going to be more heavily considered, then it is desirable for Canada to have enough vaccine antigen in our bank to deal with the largest possible isolated event. Canada, through the North American FMD Vaccine Bank (NAFMDVB), has signed an arrangement with New Zealand.
and Australia FMD Vaccine Banks to share their banks in the event of an outbreak. The NAFMDVB also has access to some South American FMD strains by way of a supply contract with a vaccine manufacturer in Argentina.

The main concern with vaccination is that it can prolong a country’s return to FMD freedom without vaccination status. This is because it continues to impact future trade until all vaccinated animals have been tested and removed from the population and the OIE has reinstated the country as FMD-free without vaccination. There seems to be a lot of potential with the development of DIVA (Differentiate Infected from Vaccinated Animals) vaccines. All vaccine concentrates held by the NAFMDVB are DIVA capable. The CFIA has a DIVA test which distinguishes animals that were vaccinated from animals that are infected. The OIE requires that all animals that are found infected be stamped out; however, animals that had not been infected could be transported to a nearby slaughter facility to be slaughtered for in-country consumption. The alternative is to stamp out all infected animals as well as all uninfected vaccines on a premises and dispose of them all by burial, burning, or rendering the carcasses (put in chute, captive bolt, remove from chute, dispose of carcass, repeat) which is quite inefficient. This old stamping out strategy would also not sit well with the public as was apparent when an FMD outbreak occurred in the United Kingdom in 2001. Canada’s DIVA test technology was developed in Winnipeg at the CFIA’s National Center for Foreign Animal Disease (NCFAD) and is, by way of an agreement with the Pan American Foot-and-Mouth Disease Center (PANAFTOSA), being used for surveillance on FMD vaccinated animals in South America. The CFIA will be provided with valuable data as to the effectiveness of the test, which will allow NCFAD to continue to refine and validate its use (8). A DIVA test provides proof that vaccinated animals are carrying antibodies to the vaccine strain of the virus and not antibodies to the wild virus. This could allow a country to use vaccination as a control strategy without prolonging its return to FMD-free status, provided all vaccinated animals are tested.

The OIE has yet to harmonize the waiting periods for countries using an emergency vaccination strategy. Current rules allow previously FMD-free countries to return to FMD-free without vaccination status within about 3 months if all vaccines are stamped out versus 6 months if vaccines are all tested and animals found not to have been infected are allowed to live. The Quad-countries (Canada, USA, Australia, and New Zealand) are lobbying the OIE to harmonize these timeframes and are also pushing for a process to allow the emergency creation of zones to allow trade to continue from certain disease-free areas of a country during an outbreak. If the vaccinating country could implement emergency zoning which would encompass all vaccines, while returning the remainder of the country to freedom and allow for trade, this would change how we deal with vaccinated animals and would allow us to use a vaccinate to live policy. This would provide a very effective control strategy for small outbreaks in more central locations as well as large outbreaks isolated to one premises. Early signs indicate that a change to the general chapter on zoning could be made now (May 2018), and hopefully the changes to the FMD chapter will follow by May 2020. Unfortunately, it will be difficult to have a final control plan in place until some of these changes are accepted by the international community. In the meantime, this does not prevent us from working towards the modernization of our response plan with these time frames in mind.

There are several other animal-related issues in Canada that are worth mentioning: the growth of small ruminant farm operations, a rise in backyard cloven-hooved animals, and the presence of ruminant wildlife species (deer and elk). The role of wildlife in spreading FMD is unknown but, as for small ruminants, they can become infected with and spread the virus. These animals, especially goats, seem to be much more resistant to the development of clinical signs and may go undetected allowing for silent spread of the FMD virus. As small ruminant pets may be seen by small animal practices and not by food animal veterinarians, it is paramount that small animal veterinarians are also aware of the clinical signs and implications of FMD. There is no way to vaccinate, control, or trace back any transmission via this route as backyard cattle, sheep, goats and pigs are very often not known to veterinarians. These animals present a significant challenge in FMD control; one that should be considered in detail by an expert advisory group.

The idea to mimic the Australian model of FMD control funding was also discussed. The concept is to approach the farm commodity groups to put forward a fair contribution each year towards FMD preparedness in order to develop a pool of money that would grow if Canada remained FMD-free and could then be called upon in the event of an outbreak. This financial pool would be useful in compiling the resources necessary to formulate, model, and train on our modern FMD response plans and could also be used for compensation apart from government funding. Cooperation from a national agriculture group, such as the National Farmed Animal Health and Welfare (NFAHW) council, would be needed as an organization in the best position to coordinate this. These organizations tend to be busy with other initiatives; however, the resources could likely be put in place to handle such a request as this, with support from other industry and veterinary organizations.

Finally, a point that was not discussed in detail on the trip to Lyon but is of equal importance would be education. Within our group, only 1 person had seen clinical FMD. In fact, most veterinarians and producers in Canada have likely never seen clinical FMD, nor would this possibility initially cross their minds when faced with affected animals in the early stage of an outbreak. Since the effectiveness of any control program relies on early recognition, confirmation, and action, recognizing this disease as quickly as possible should be paramount to any country’s control strategy. Therefore, education of veterinarians and producers on the signs and the potential impact of FMD should be done. There are initiatives underway to evaluate the feasibility of modifying the European Commission for the control of Foot and Mouth (EuFMD) group course to reflect Canadian policies. This could then be delivered to Canadian veterinarians (both public and private) as well as industry representatives each year, in order to enhance awareness and recognition of this disease.

It seems that despite our best efforts, Canada is not currently as prepared for the potential of a large-scale FMD disease...
outbreak as many may have thought. We are a few steps behind other countries such as Australia in revising our strategies and with the consideration that is now being given to the use of vaccination, it is a good time to come up with a modern, all-inclusive national approach to FMD control. An outbreak would affect the entire country, even if that outbreak was to occur in the United States, and each region would need to be dealt with differently. A vaccinate-to-live control strategy should be our ultimate goal to control moderate to large-sized outbreaks, outbreaks in central locations, or those within a region with a large density of animals. In small outbreaks in remote, less animal dense areas, a stamping out approach would still be feasible. Policy changes from the OIE are underway and will need to be finalized before Canada will be able to have this all-encompassing and modern control strategy. In the meantime, however, we should focus work on important aspects that would be required for such a control strategy. These would be aimed primarily at enhanced education, having all players involved and in agreement with the discussions around our plan, and gathering a source of funding and resources to better enable us to ultimately develop a more modern control strategy. A new strategy may allow us to once again say that Canada would be able to deal with a large-scale FMD outbreak quickly and efficiently.

References

When Ms. Mayhew and her dog, Burt, arrive for their appointment, Dr. Schoerner cannot believe how much the dog has deteriorated in the year since she last saw him. Instead of the cheerful, outgoing terrier mix she remembered, she saw an animal which looked exhausted and defeated. Without thinking, the practitioner blurted, “What happened to Burt? He was such a happy dog!” As soon as she said this though, the look on Ms. Mayhew’s face made it clear that this was not what the client wanted to hear. The veterinarian immediately apologized profusely for offending her client, then added that she always had had a soft spot in her heart for the little dog. The look Ms. Mayhew gave Burt made it clear that she felt the same way about him, too.

Sensing that something significant had changed in the client and dog’s environment that had distressed them, but not wanting to say the wrong thing again, Dr. Schoerner began giving Burt a physical examination. During this, she kept up a relaxed, running commentary regarding her findings to keep her client engaged. Once assured that the dog was basically healthy, she turned her attention to the raised red lesion on the dorsal surface of the terrier’s right front paw.

“Burt started licking that area after my husband’s son, Kenny, moved in with us about 10 months ago,” Ms. Mayhew explained. “Kenny has multiple behavioral and developmental issues including attention deficit hyperactivity and autism spectrum disorder that overwhelmed his mother. I love Kenny as much as his father does so there was no question about his coming to live with us. When Kenny’s psychologist suggested getting him an emotional support animal, he said that Burt would be perfect because he was such a happy little dog. Burt has helped Kenny and certainly has made things easier for us because Kenny prefers Burt’s company. But my husband and I are concerned about the toll this may be taking on Burt.”

Welcome to the new world in which the demand for well-trained service animals to assist those with a range of mental and emotional disabilities far outstrips the supply. To fill this void, desperate patients or their loved ones may attempt to press family pets or shelter or rescue animals into service as real or de facto emotional support animals (ESA). How well this works depends on multiple factors, including the animal’s ability to handle the responsibilities associated with the human patient’s needs.

When these relationships result in physical or behavioral problems in the animal, it is the veterinarian’s responsibility to address these. However, doing so requires quality practitioner-client communication skills. As Dr. Schoerner discovered, these skills may be difficult to summon at a time when an animal’s deteriorating condition takes the veterinarian by surprise and triggers remarks that could weaken rather than enhance the practitioner-client relationship.

Consider the dilemma faced by the Mayhews who are among the population that benefit directly or indirectly from the presence of a de facto ESA. In these situations, the temptation may be great to focus solely on the benefits the animal generates for the patient. Burt’s beneficial effects on Kenny’s well-being were such that neither Ms. Mayhew nor her husband could see the toll providing these on-demand services 24/7 was taking on their dog. They did not make the connection between his chronic licking and Kenny’s periodic outbursts until they noticed the angry red lesion on Burt’s paw. But even then, the fear of Kenny regressing without Burt’s presence caused them to surf the Internet looking for other causes and instant cures.

Initially they decided that allergies must be causing the problem and began washing Burt’s paws after every trip outside. However, this caused the terrier to lick his foot even more, as did Kenny’s unpredictable attempts to help with the cleansing process. During the following months, they applied multiple over-the-counter sprays, ointments, and powders to the area, some of which made the problem worst. Ultimately, they decided that simply bandaging the foot gave the best results. Burt continued to lick but was content to lick the bandage. However, Kenny did not like the bandage and often removed it.

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received the reminder for Burt's annual check-up, they realized that they no longer could deny the problem.

Ms. Mayhew provided all this information when Dr. Schoerner asked for more information about Burt's foot. “I had no idea she'd reveal so much after my initial remark,” Dr. Schoerner later told her partner. “Once I knew all the family had gone through, I realized that the parents' fear that I'd condemn them for Burt's condition probably contributed to their delay seeking help for him.”

In addition to reminding her to fine-tune her communication skills in general, this experience also convinced the practitioner that she needed to become better informed about this segment of the companion animal population if she wanted to help her clients and their animals. Although literature searches for studies on the welfare of de facto ESA like Burt yielded no results, she did find one white paper on the welfare of animals used in animal-assisted interventions (https://habricentral.org/resources/55219/download/he_brief_welfare_and_hai_20160208access002.pdf) and 2 articles by Burrows et al (http://cnaf.net/documents/NationalServiceDogsStudy.pdf, https://pdfs.semanticscholar.org/6775/a8f1289a7b64ef8464808ea85dca5d0e1d3e.pdf) about trained service dogs in households with autistic children that gave her a better understanding of the many factors involved.

Next Dr. Schoerner explored the options available to the family that would improve the quality of Burt's life without unnecessarily undermining that of the Mayhews and their son. Heading the list was the addition of a professionally trained psychiatric service dog to the household to meet Kenny's special needs. This would allow Burt to resume his role as a family pet. The second was to have Burt evaluated by an experienced service dog trainer to determine his fitness to function as a service animal. If he possessed the necessary physical and mental qualities to do so, then he could be trained properly to help the Mayhews' son. Option 3 involved the clients training Burt themselves. In all cases, the dog providing the service(s) must have exercise and play breaks as well as time for sufficient restorative sleep built into his daily schedule. Each option had its costs and benefits.

With her clients' permission, Dr. Schoerner also contacted the psychologist who recommended the dog to discuss Burt's and the Mayhews' experiences. Being a dog lover himself, the psychologist was horrified to learn about Burt's condition. Primed by the articles in his professional journals regarding the many benefits human-animal interactions afforded human patients with mental and emotional disabilities, he had assumed that doing so would not have negative impacts on the animals' well-being. Once he also recognized the value of a comprehensive view that took human and animal welfare into account, he proposed that they share any relevant material they encountered in their own areas of expertise regarding the use of service or support animals that might benefit the other.

In retrospect, getting Burt's paw healed and him back to his former happy self had all the characteristics of a OneHealth problem without the glamour, let alone any readily available tools to address it. It also had all the necessary components for a communications disaster for Dr. Schoerner. Fortunately, she was able to muster the self-control to engage herself and her client in the familiar routine of examining the animal. This enabled her to diffuse any negative emotions her impulsive comment about the dog's poor condition may have triggered in her client that, in turn, made it easier for Ms. Mayhew to share personal details about what was occurring in the household that was affecting her dog that she might have withheld otherwise. Once client and clinician developed this degree of professional rapport and trust that made it easier for Dr. Schoerner to request permission to contact the child's therapist and inform him about the problems experienced by the animal he unwittingly recommended for his patient. And once that line of communication was established, both clinicians gained access to additional helpful information about this growing segment of their respective practices that they might not have had otherwise.

Most veterinary practitioners would agree that the last thing they need are the kinds of animal medical, behavioral, bond, legal, and ethical dilemmas that currently attend the increased use of other- or self-prescribed companion animals as adjunct treatments for an increasing array of human mental and emotional disabilities. They do not need to worry about what kinds of information they can request regarding the animal's training and functions or the client's ability to provide any necessary care. Nonetheless, these clients and animals can and will show up in veterinary practices nationwide.

Although it may seem that all signs point to yet another practice burden lacking a convenient one-size-fits-all protocol for guidance, all practitioners have or can gain the one tool that will eliminate much of the stress associated with these clients and their animals: quality communication skills.
Urinary calculi in a shih tzu dog with hyperadrenocorticism

Natalie Swieton

Abstract — An 11-year-old spayed female shih tzu dog was presented with pollakiuria, stranguria, and hematuria. Radiographs revealed a large number of radiodense urinary calculi within the bladder. Physical examination, complete blood cell count, biochemistry and ACTH stimulation test suggested possible hyperadrenocorticism. A cystotomy was performed and the patient was treated for hyperadrenocorticism.

Résumé — Calculs urinaires chez une chienne Shih Tzu atteinte d’hyperadrénocorticisme. Une chienne Shih Tzu stérilisée âgée de 11 ans a été présentée avec de la pollakiurie, de la strangurie et de l’hématurie. Les radiographies ont révélé un grand nombre de calculs urinaires radio-opaques dans la vessie. L’examen physique, une formule sanguine complète et la biochimie ont suggéré la possibilité d’hyperadrénocorticisme. Une cystotomie a été réalisée et la patiente a été traitée pour l’hyperadrénocorticisme.

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An ACTH stimulation test was performed with cosyntropin (Cortrosyn; Amphastar Pharmaceuticals, Rancho Cucamonga, California, USA), 0.06 mg/kg BW, IM, which showed elevated pre-cortisol concentration (174 nmol/L; RI: 28 to 120 nmol/L) and elevated 1 h post-cortisol concentration (737 nmol/L; RI: 220 to 550 nmol/L). The patient was diagnosed with hyperadrenocorticism and treatment with trilostane (Vetoryl; Dechra, Skipton, UK) was initiated at 2.91 mg/kg BW, PO, q24h until the time of a recheck in 14 d.

Meloxicam (Metacam Oral Suspension; Boehringer Ingelheim, Burlington, Ontario), 0.1 mg/kg BW, PO, q24h for 5 d, was prescribed for pain management, marbofloxacin was continued, and the patient received probiotics (Progut Plus Powder; Ceva Animal Health, Cambridge, Ontario), 2 g, PO, q12h to help the gastric flora to withstand the effects of antibiotic administration.

A cystotomy was performed 7 d following initial presentation. A retrograde urinary catheter was passed before surgery to check for patency and allow intraoperative flushing. A ventral midline incision was made from xiphoid to pubis, at which time the skin was noted to be thin and the abdominal wall appeared stretched. Urine was removed from the bladder by cystocentesis and submitted for urinalysis and culture and sensitivity (IDEXX Laboratories, Markham, Ontario). The lumen of the urinary bladder had innumerable uroliths, ranging from < 1 mm to > 3 cm in diameter. Stones were manually removed from the bladder and lavaged through the urinary catheter using warm saline. Urinary calculi were submitted for analysis (Canadian Veterinary Urolith Centre, Guelph, Ontario). A small section of the bladder wall was excised for aerobic and anaerobic culture and sensitivity. The bladder was closed with 2-layer simple continuous and Cushing patterns. Intra-operative radiographs revealed no stones remaining in the bladder and urethra. The abdomen was closed in 3 layers.

The patient was administered penicillin (Duplocillin; MSD Animal Health, Kirkland, Quebec), 0.1 mL/kg BW, IV, cefovecin (Convenia; Zoetis), 7.8 mg/kg BW, IV, hydromorphone (HYDROMorphone HP; Sandoz, Boucherville, Quebec), 0.1 mg/kg BW IV, and meloxicam (Metacam; Boehringer Ingelheim, Burlington, Ontario), 0.05 mg/kg BW, IV, during the surgery. Meloxicam was prescribed for postoperative pain.

Urinalysis of the submitted cystocentesis sample identified red turbid urine with a specific gravity of 1.020, pH of 8.0, large numbers of RBCs, and proteinuria. Urine sediment was composed of high numbers of neutrophils, few transitional epithelial cells, a moderate to high number of white blood cells, and triple phosphate crystals. Urine, bladder wall, and bladder stone swab culture yielded no bacterial growth.

Analysis of the calculi identified 2 types of stones: i) smooth irregular beige stones composed of approximately 50% struvite and 50% calcium phosphate carbonate at the nidus, stone, and shell; and ii) smooth, oval, and tan stones composed of approximately 95% calcium phosphate carbonate and 5% struvite.

On a follow-up visit to the clinic 14 d following cystotomy, the patient appeared to have fully recovered from surgery without complications and was urinating normally. An ACTH stimulation test performed 4 h following administration of trilostane (Vetoryl; Dechra), 2.91 mg/kg BW, PO, revealed low pre-cortisol levels (< 27.6 nmol/L; RI: 28 to 120 nmol/L), and post-cortisol levels (183 nmol/L; RI: 220 to 550 nmol/L). The dose of trilostane was reduced to 10 mg (0.97 mg/kg BW), q24h for 13 d, until the next re-check.

**Discussion**

In this patient, the development of urinary stones was likely multifactorial with hyperadrenocorticism and patient signalment as likely contributing factors to the development of mixed struvite and calcium phosphate stones.
An examination of urinary calculi samples submitted to the Canadian Veterinary Urolith Centre from 1998 to 2008 showed that 39% of canine calculi were struvite and only 2% calcium phosphate in composition (1). Of all samples analyzed, over half were accounted for by shih tzus, miniature schnauzers, bichon frises, lhasa apsos, and Yorkshire terriers (1). It has been proposed that small breed dogs are predisposed to urinary stone formation due to smaller urine volumes relative to bladder size, and a decreased frequency of micturition (2). This patient’s history of urolith development at a young age further suggests genetic predisposition to formation of urinary calculi (3).

Calcium phosphate uroliths are uncommon, and are usually promoted by an underlying metabolic disorder such as hyperparathyroidism, renal tubular acidosis, excess dietary calcium intake, and, as in this case, hyperadrenocorticism (1,4,5). One study showed that dogs with hyperadrenocorticism had a 10-fold higher likelihood of developing calcium-containing uroliths than do normal dogs (6). Elevated blood cortisol has been implicated in increasing glomerular filtration of calcium, thus promoting high urine calcium levels and likelihood of formation of calcium phosphate calculi (7,8).

Struvites in dogs are frequently a result of urinary tract infections by urease-producing bacteria, most notably, *Staphylococcus pseudintermedius* and *Proteus* spp. (9). By-products of urea metabolism by these organisms promote a neutral to alkaline urine environment. The basic urine pH decreases the solubility of struvite crystals and promotes calculus formation (9,10). This patient’s urine pH on presentation was 7.5, consistent with a struvite-promoting environment. In the described case, it is possible that elevated glucocorticoid levels from hyperadrenocorticism caused immunosuppression and increased susceptibility to urinary tract infection (11). Glucosuria, though not detected in this patient, may facilitate bacterial growth and reduce neutrophilic response to infection (11).

Despite lifelong maintenance on a struvite dissolution and calculus prevention diet, this patient had large quantities of mixed calculi composed of struvite and calcium phosphate. It is important to note that dietary control of struvites may fail in the presence of an uncontrolled urinary tract infection by urease-producing bacteria (12). While it was known that the patient had a history of calculi early in life, information on calculus type and course of treatment at that time is unknown. It is possible that dietary medical therapy was not effective in elimination of the previous urinary stones, which persisted as a nidus for infection and subsequent stone formation (13). Attempts to dissolve the stones through diet may also fail due to insufficient urine volume to bathe the stones; both small breed and presence of pre-existing urinary calculi are possible contributors (14).

Additionally, mixed calculi with components not amenable to dietary dissolution may lead to failure (10). As such, a shell of calcium phosphate surrounding the struvite component may have reduced the effectiveness of therapy (10,13,15).

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**References**

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