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Evaluation of coagulation via thromboelastography in healthy horses administered dexamethasone

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Contents Table des matières

SCIENTIFIC RUBRIQUE SCIENTIFIQUE

ARTICLES
1232 Intraoperative acridine orange photodynamic therapy and cribriform electron-beam irradiation for canine intranasal tumors: A pilot study
Takuya Maruo, Koichi Nagata, Yasuhiro Fukuyama, Yuki Nemoto, Shinpei Kawarai, Yukihiro Fujita, Tomohiro Nakayama

1239 Sialolithiasis in horses: A retrospective study of 25 cases (2002–2013)
Nicholas Carlson, Tim Eastman, Laramie Winfield

1245 Survey of western Canadian veterinary practices: A demographic profile
Murray D. Jelinski, Katrina K. Barth

1252 Evaluation of plasma inflammatory cytokine concentrations in racing sled dogs
Dirsko J. F. von Pfeil, Bethany P. Cummings, John P. Loftus, Corri B. Levine, Sabine Mann, Robert L. Downey, Caroline Griffiths, Joseph J. Wakshlag

1257 Efficacy of a single-formula acupuncture treatment for horses with palmar heel pain
Katherine A. Robinson, Stephen T. Manning

CASE REPORTS RAPPORTS DE CAS
1261 Dorsal midbrain syndrome associated with persistent neck extension: Clinical and diagnostic imaging findings in 2 dogs
Sara Canal, Massimo Baroni, Cristian Falzone, Giulia M. De Benedictis, Marco Bernardini

1266 Longitudinal evaluation of diagnostics in experimentally infected young calves during subclinical and clinical paratuberculosis
Rienske A.R. Mortier, Herman W. Barkema, Karin Orsel, Gregory P. Muench, Janet M. Bystrom, Oscar Illanes, Jeroen De Buck

1275 Cutaneous squamous cell carcinoma in an African pygmy hedgehog (Atelerix albiventris)
Émilie L. Couture, Isabelle Langlois, Ariane Santamaria-Bouvier, Marie-Odile Benoit-Biancamano

1279 Acute idiopathic polyneuritis with spontaneous remission in an Abyssinian cat
Aurélien Jeandel, Kaspar Matiasek, Stéphane Blot

1283 Successful treatment of Solanum dulcamara intoxication in a Labrador retriever puppy
Megan Kees, Nicole Beckel, Claire Sharp

1287 Bilateral renal T-cell lymphoma with hepatic infiltration and secondary polycythemia in a dog: Utility of cytology slides
Rémi Froment, Carolyn Gara-Boivin

BRIEF COMMUNICATION COMMUNICATION BRÈVE
1271 Evaluation of coagulation via thromboelastography in healthy horses administered dexamethasone
Jenna Woodman, Catherine R. Wagg, Søren R. Boysen, Renaud Leguillette, Kyle Mizen, Marie-France Roy

1221 QUIZ CORNER TEST ÉCLAIR

1214 ACKNOWLEDGMENT OF REVIEWERS/TRANSLATORS REMERCIEMENT AUX ÉVALUATEURS ET AUX TRADUCTEURS
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Contents Table des matières

FEATURES RUBRIQUES SPÉCIALES

EDITORIAL ÉDITORIAL
1215 Student debts and low wages Dette étudiante et faibles salaires Carlton Gyles

1217 VETERINARY MEDICAL ETHICS DÉOHTOLOGIE VÉTÉRINAIRE

COMMENTARY COMMENTAIRE
1293 Taking care of our professional responsibility to prescribe — for ourselves, our children, and our community Kelly M. Butler OVC 1986

THE ART OF PRIVATE VETERINARY PRACTICE L’ART DE LA PRATIQUE VÉTÉRINAIRE PRIVÉE
1295 Stress and communication Myrna Milani

BOOK REVIEWS COMPTES RENDUS DE LIVRES
1260 Missing Microbes. How the Overuse of Antibiotics is Fueling our Modern Plagues John Prescott
1282 Small Animal Ophthalmic Atlas and Guide Barb Muzyka

NOTICES ANNONCES
1251 Books Available for Review Livres disponibles pour compte rendu
1291 Index of Advertisers Index des annonceurs
1297 Classifieds Petites annonces

NEWS | NOUVELLES
1223 NEWS NOUVELLES Heather Broughton, Isabelle Vallières

Contributors

“Instructions for authors” are available online (www.canadianveterinarians.net).

The Canadian Veterinary Journal
La Revue vétérinaire canadienne

339 rue Booth Street
Ottawa, Ontario K1R 7K1
Telephone: (613) 236-1162
Fax: (613) 236-9681
E-mail: hbroughton@cvma-acmv.org
Website/Site Web: www.canadianveterinarians.net
www.veterinarescanada.net

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L’Association canadienne des médecins vétérinaires 2015

The Canadian Veterinary Journal is indexed or abstracted in:
- AGRICOL, Biological Abstracts, Capsule Report, Current Contents — Agriculture,
- Derwent Veterinary Drug File, EMBASE/Excerpta Medica,
- Index Veterinarius, Index Medicus, Quarterly Index, Science Citation Index, Small Animal Practice, Veterinary Bulletin, Veterinary Reference Service, Veterinary Update.

Photo by/Photo de : Andy Allen, Saskatoon, Saskatchewan

Typesetting/Typographie
AN Design Communications
Printed by/Imprimé par
The Lowe-Martin Group
Ottawa, Ontario
ISSN 0008-5286

Return undeliverable Canadian addresses to:
339 rue Booth Street
Ottawa, Ontario K1R 7K1
e-mail: hbroughton@cvma-acmv.org

Subscriptions (2015). Annual: Canada $195 + applicable GST or HST; foreign $210 US; institution/agency $225. Express subscriptions available. Single issue/back issue: $25 each + GST or HST, if applicable. (All prices subject to change.) Missing issues will be replaced if the Subscriptions Office is notified within 6 months (for requests within Canada) and 1 year (for requests from abroad) of the issue date. The publisher expects to supply missing issues only when losses have been sustained in transit and when the reserve stock will permit. Telephone (613-236-1162) or (1-800-567-2862) and fax (613-236-9681) orders accepted with a valid Visa or MasterCard number. Please advise the publisher of address changes promptly.


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The editors and staff of The Canadian Veterinary Journal are pleased to have as readers student veterinarians at Canadian veterinary colleges! The production and distribution of student subscriptions is made possible through the generous sponsorship of Scotiabank

La Revue vétérinaire canadienne est heureuse de compter parmi ses lecteurs les étudiants en médecine vétérinaire des collèges vétérinaires au Canada. La production et la distribution des abonnements des étudiants ont été rendues possible grâce au généreux soutien de Banque Scotia

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09/2015
Acknowledgment of Reviewers/Translators

Les rédacteurs et le Comité de rédaction souhaitent aussi remercier les traducteurs suivants pour leurs excellents services.

Isabelle Vallières • André Bisaillon • Serge Messier

Les commentaires et critiques constructives de nombreux collègues contribuent au maintien du niveau d’excellence des articles scientifiques publiés dans La Revue vétérinaire canadienne.

Voici la liste des lecteurs des manuscrits qui ont été publiés ou rejetés pour la période de novembre 2014 à octobre 2015. La Rédaction et le Comité de rédaction tiennent à remercier ces collègues du temps et des efforts qu’ils ont consacrés à l’examen minutieux des manuscrits.

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The editors and constructive criticisms of many colleagues help to maintain a high standard for scientific articles published in The Canadian Veterinary Journal. Reviewers of manuscripts published, rejected, or expired during the period November 2014 to October 2015 are listed below. The Editors and Editorial Board wish to thank these colleagues for the donation of their time and the sharing of their expertise.
Editorial

Student debts and low wages

Student debt has for some time been an area of concern for students, educators, and parents. The problem is particularly serious for students in professional programs such as veterinary medicine that typically involve being in university for 6 to 8 years. The average educational debt for students graduating from a DVM program in the United States in 2013 was $162 113 and over 50% of graduates had debt in excess of $150 000 (1). Canadian DVM graduates also have substantial debt although they are in far better shape than their American counterparts. The recent new graduate survey of the class of 2014 (2) showed that the mean debt of 2014 Canadian DVM graduates was $65 744 and ranged among colleges from $31 220 for graduates from the Faculté de médecine vétérinaire, Université de Montréal, to $140 421 for graduates from the Atlantic Veterinary College.

What can be done about this problem? Starting salary also needs to be considered in any discussion of debt of DVM graduates. The mean starting salary for new Canadian DVM graduates in 2014 was $60 466.

Dr. John Maddigan, an Oregon practice owner, has some suggestions (3). He argues that some of the cost of education of veterinarians, who generate income for practice owners, should be borne by practice owners and some by pet owners, who benefit from the services of practitioners. True to his conviction, Dr. Maddigan has established a program whereby his hospital, since 2010, has been contributing scholarships to the veterinary school at Oregon State University. He has generated funds by adding 50 cents to every examination and to each bottle of private-label vitamins, shampoo, and dental chews sold in his clinics. This year, $10 000 was awarded as scholarships to students. Dr. Maddigan suggests that if every hospital took similar action we could substantially reduce student debt. He warns, however, that if tuition fees rise faster than the rate of inflation then this may render his approach ineffective, that colleges must end the increases in class sizes, and there must be some reduction in the number of veterinary hospitals. Dr. Maddigan depuis un certain temps, la dette étudiante est un sujet qui préoccupe les étudiants, les éducateurs et les parents. Le problème est particulièrement grave pour les étudiants inscrits à des programmes professionnels, comme la médecine vétérinaire, qui nécessitent habituellement de six à huit années d’études universitaires. En 2013, la dette d’éducation moyenne pour les étudiants achévant un programme de D.M.V. aux États-Unis était de 162 113 $ et la dette de plus de 50 % des diplômés dépassait 150 000 $ (1). Les diplômés en médecine vétérinaire canadiens ont aussi accumulé une dette importante, mais ils sont en bien meilleure position que leurs homologues américains. Le récent sondage auprès des finissants de la promotion 2014 (2) indiquait que la dette moyenne des diplômés canadiens du D.M.V. s’établissait à 65 744 $ et s’échelonnait entre les écoles de 31 220 $, pour les diplômés de la Faculté de médecine vétérinaire de l’Université de Montréal, à 140 421 $ pour les diplômés de l’Atlantic Veterinary College.

Que peut-on faire pour aborder ce problème? Le salaire de départ doit aussi être considéré dans toute discussion de la dette des diplômés du D.M.V. En 2014, le salaire de départ moyen des finissants en médecine vétérinaire canadiens était de 60 466 $.

Le Dr John Maddigan, un propriétaire de pratique de l’Oregon, offre quelques suggestions (3). Il fait valoir qu’une partie du coût de la formation des vétérinaires, qui génèrent des recettes pour les propriétaires de pratique, devrait être assumée par les propriétaires de pratique et certains propriétaires d’animaux, qui bénéficient des services des praticiens. Fidèle à ses convictions, le Dr Maddigan a établi un programme dans sa clinique et, depuis 2010, il offre des bourses aux étudiants de l’école de médecine vétérinaire de l’Université d’État de l’Oregon. Il a recueilli des fonds en ajoutant 50 cents à chaque examen, à chaque flacon de vitamines et de gâteries dentaires et à chaque bouteille de shampoing qui sont vendus dans ses cliniques. Cette année, des bourses d’une valeur de 10 000 $ ont été décernées aux étudiants. Le Dr Maddigan suggère que si chaque clinique prenait des mesures semblables, nous pourrions considérablement réduire la dette étudiante.
EDITORIAL

The really difficult part of the proposal is arriving at a reduction in numbers of graduates. Publicly funded and private not-for-profit veterinary schools need to balance their budgets and for-profit veterinary schools need to make a profit; in each case that requires a certain number of students. Those numbers can be reduced only if additional revenues can be found or if efficiencies can be achieved. Furthermore there is no mechanism to ensure a fair and orderly reduction in student intake by all the accredited veterinary schools in North America and the Caribbean. The cost of veterinary education has been increasing because of more sophisticated standards of care and new and costly equipment and facilities for teaching students and conducting research to generate new knowledge. So substantial cost savings along with increased quality of education seem unlikely. Applications to veterinary schools by well qualified students continue to outnumber available places in spite of the knowledge of high student debt and low wages. Thus the prospects for lowering the number of graduates are weak and it appears that we will continue to have a large supply of veterinary graduates for some time.

What can we do under the circumstances? Manipulation of supply of professionals to meet perceived demands is very difficult to manage and it is likely that it is the market that will eventually affect supply. In the interim, veterinary graduates are likely to respond with innovation and creation of non-traditional careers.

Carlton Gyles

References


Cependant, il met en garde qu’une hausse des frais de scolarité plus rapide que le taux d’inflation pourrait rendre cette approche inefficace, que les collèges doivent cesser d’augmenter la taille des promotions et qu’il doit y avoir une certaine réduction du nombre de cliniques vétérinaires. Le Dr Maddigan recommande une réduction graduelle du nombre d’étudiants ainsi qu’une amélioration de la qualité de la formation afin de créer un équilibre entre le nombre de vétérinaires et la demande des services vétérinaires, ce qui servira à améliorer les salaires.

Même si de nombreux anciens appuient déjà leur alma mater par divers moyens, il est louable de vouloir augmenter les bourses. Cependant, je suggère que l’augmentation des bourses en fonction du besoin plutôt que du rendement universitaire pourrait être préférable. Le volet de la proposition qui sera vraiment difficile à réaliser est la réduction du nombre de finissants. Les écoles de médecine vétérinaire publiques et privées sans but lucratif doivent équilibrer leurs budgets et les écoles de médecine vétérinaire à but lucratif doivent réaliser un profit et, dans chaque cas, un certain nombre d’étudiants est requis. Le nombre peut être réduit seulement si on peut trouver des sources de revenu additionnel ou si on peut réaliser des gains d’efficacité. De plus, il n’y a aucun mécanisme visant à assurer une réduction juste et ordonnée de l’admission des étudiants par toutes les écoles de médecine vétérinaire agréées en Amérique du Nord et dans les Antilles. Par ailleurs, le coût de la formation vétérinaire a augmenté en raison des standards de soins de plus en plus sophistiqués ainsi que des installations et des appareils nouveaux et dispendieux pour l’enseignement aux étudiants et la réalisation de travaux de recherche pour produire de nouvelles connaissances. Des économies substantielles accompagnées d’une amélioration de la qualité de l’enseignement semblent donc improbables.

Les demandes d’admission aux écoles de médecine vétérinaire provenant d’étudiants qualifiés devraient continuer de surpasser le nombre de places disponibles même si l’on connaît la situation de la dette étudiante élevée et des faibles salaires. La possibilité de réduire le nombre de diplômés est donc mince et il semble que nous continuerons d’avoir un grand nombre de finissants en médecine vétérinaire pendant encore quelque temps.

Que pouvons-nous faire dans les circonstances? La manipulation de l’approvisionnement des professionnels afin de satisfaire aux demandes perçues est très difficile à gérer et il est probable que le marché influencera ultérieurement l’offre. Dans l’intérim, les finissants en médecine vétérinaire réagiront probablement en innovant et en se taillant des carrières non traditionnelles.

Carlton Gyles

Renvois

Veterinary Medical Ethics
Déontologie vétérinaire

Ethical question of the month — December 2015

A beef farmer’s wife presents you with a stray dog that had been hanging around the farm for the past month and which they had been feeding kitchen scraps. She had run over it in the driveway and has brought it to you for an examination. On palpation you realize that the left femur is fractured. You quote her a price for repair and one for euthanasia. She wants to discuss this with her husband. You heavily sedate the dog, provide analgesia, and give her some additional analgesics to use while a decision is made. You suspect the producer will shoot the dog when he gets home. Six months later you are called to the farm for a calving. The stray dog comes bounding out to greet you. You ask the farmer where he had taken the dog for surgery. “Once I ran out of those pain pills I just switched him to aspirin and within a few weeks he had started using it again,” is the response. You are shocked that the dog was left with a broken leg, shocked that it is now running around at your feet, and realize you should have followed up to ensure the dog was euthanized. In another way you are glad that the dog was left to heal on its own and is now living a good life.

Was offering surgery or euthanasia the only appropriate options to suggest in this case?

Submitted by Joel Rumney, Midland, Ontario.

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

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

Les réponses au cas présenté sont les bienvenues. Veuillez limiter votre réponse à environ 50 mots et nous la faire parvenir par la poste avec vos nom et adresse à l’adresse suivante : Choix déontologiques, a/s du D’ Tim Blackwell, 6486, E. Garafraxa, Townline, Belwood (Ontario) N0B 1J0; téléphone : (519) 846-3413; télécopieur : (519) 846-8178; courriel : tim.e.blackwell@gmail.com

Les propositions de questions déontologiques sont toujours bienvenues! Toutes les questions et situations présentées dans cette chronique s’inspirent d’événements réels dont nous modifions certains éléments, comme les noms, les endroits ou les espèces, pour protéger l’anonymat des personnes en cause.

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Ethical question of the month — October 2015

Veterinarians ask situation-specific questions of pharmaceutical companies regarding the use of their products. When pharmaceutical companies do not have the answers to these questions, they often undertake trials to provide practitioners with the information they request. Pharmaceutical companies prefer to have the research performed at appropriate universities where faculty are knowledgeable and competent in the specific areas of investigation. These product-specific research projects are difficult to fund through granting agencies. Even though researchers are encouraged to publish their findings in peer-reviewed and refereed journals regardless of the outcomes, results from industry-sponsored research are nevertheless considered suspect due to the source of the funding. Sometimes, the objectivity of the researchers themselves is called into question. Similar concerns have arisen in human medicine as evidenced by recent commentaries in the New England Journal of Medicine, http://www.nejm.org/doi/full/10.1056/NEJMms1502498 (Last accessed August 17, 2015). Do veterinarians and other professionals serve the veterinary industry (and their clients) by dismissing this type of research based on the source of the funding rather than on its scientific merit?

Question de déontologie du mois — Octobre 2015


An ethicist’s commentary on data falsification

The scientific community has unfortunately tended to take an extremely Pollyannish attitude towards honesty within its ranks. Perhaps the most extreme instantiation of such an attitude occurred during the 1980’s, when the head of the National Academies of Science publicly stated that any scientists falsifying data or otherwise engaging in scientific misconduct, had to be seen as “mentally ill.” Shocking recent research has shown that fully two thirds of published psychological research could not be replicated.

There is no question that funding sources contribute to an atmosphere of corruption. My colleagues in agriculture regularly joke that they better achieve the results expected by the companies that fund them, or else they will never get funding in the future. One of my colleagues regularly lectures in my course in science and ethics, and recounts the pressure placed on him by a feed company not to publish his data when the results were not as expected.

There is currently unprecedented pressure placed on scientists to get funding, since public support for universities is steadily diminishing. Fields such as humanities disciplines, never greatly respected in universities, and typically neither requiring nor obtaining significant research funding, are achieving significantly truncated status in universities, as reflected in vast salary differentials between fundable and non-fundable fields. The requirements for tenure and promotion in universities have been greatly ratcheted up, creating a climate of unhealthy competition and loss of collegiality, belying the traditional ideal of a “community of scholars.” Administrators are reluctant to judge quality, and thus depend on “bean counting.”

Judging from websites reporting publication retractions as a result of scientific misconduct, such misconduct extends over all fields. What then can be done? Suggestions have been made that researchers should be judged by quality of work, not quantity. But how are such qualitative judgments to be made. “Bean counting” is far easier and less subject to challenges embodied in lawsuits. And in any case, the push for funding eclipses qualitative considerations.

Thus the issue raised in this case extends well beyond research funding in medicine, but can be seen as a structural problem plaguing science and universities. One approach to mitigating this situation to a small degree is to adopt the Australian concept of core funding, i.e., provision of relatively small amounts of research funding for anyone obtaining a university position. Australian success in immunological science attests to the potential efficacy of this approach.

As I have recounted in detail in my book, Science and Ethics (Cambridge University Press, 2006), the component of scientific ideology rife in the 20th century, that science is value-free and ethics-free, and thus that there is no call for teaching ethics in already overloaded curricula, has caused great harm to science in
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Used by veterinarians since 1994.
the area of research on human beings, animal subjects, biosafety, biotechnology, by diminishing the credibility of science in a society both ignorant of science and suspicious of its activities. While learning about ethics does not assure that students will behave ethically, exposure to thinking in ethics terms can surely enhance sensitivity to such issues, and therefore help prevent an onerous regulatory burden imposed by governments.

Bernard E. Rollin, PhD
1. A 5-month-old Boston terrier presents with a continuous left basilar murmur and bounding femoral arterial pulses. Which of the following is the most likely cause of the murmur?
   A. Ventricular septal defect
   B. Subaortic stenosis
   C. Patent ductus arteriosus (PDA)
   D. Pulmonic stenosis
   E. Mitral valve dysplasia

2. A 4-year-old West Highland white terrier is presented for mild-to-moderate pruritus of the feet and face. The pruritus originally occurred only in the spring, but now occurs during most of the year. Which of the following is the most likely diagnosis?
   A. Scabies
   B. Flea allergic dermatitis
   C. Adverse reaction to food (food allergy)
   D. Atopic dermatitis
   E. Hypothyroidism

3. A cat presents with a 5 mm central area of brown corneal discoloration. Corneal vessels extend to the edge of the lesion. The correct diagnosis of this lesion is which of the following?
   A. Eosinophilic keratitis
   B. Melting corneal ulcer
   C. Descemetocoele
   D. Corneal sequestrum

4. Which of the following antiinflammatory drugs is the most appropriate for treating an endotoxemic foal?
   A. Prednisone
   B. Aspirin
   C. Flunixin
   D. Meloxicam
   E. Phenylbutazone

Test éclair

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Q: How do you provide your patients with customized, “beyond-core” protection to help them fight off specific pathogens to which they may be exposed?
5. Which of the following is true concerning rigor mortis?
   A. It occurs within hours of the death of an animal and is a permanent condition.
   B. It begins in the myocardium, and then progresses peripherally to the extremities.
   C. It will not occur if an animal is febrile at the time of death.
   D. It is associated with increased muscle pallor.
   E. It involves smooth muscle as well as striated muscle.

(See p. 1294 for answers./Voir les réponses à la page 1294.)

Questions and answers were derived from Review Questions and Answers for Veterinary Boards 2nd ed., a 5-volume series including Basic Sciences, Clinical Sciences, Small Animal Medicine and Surgery, Large Animal Medicine and Surgery, and Ancillary Topics, by kind permission of the publisher, Mosby–Year Book, Inc., St. Louis, Missouri.
The Perfect Pair: Partners in Preventive Veterinary Care
Animal Health Week 2015 Wrap-up

The Canadian Veterinary Medical Association (CVMA) celebrated its 30th successful Animal Health Week in October. With nearly 200 clinics and animal hospitals participating, thousands of animal families from coast to coast were introduced to this year’s theme of The Perfect Pair: Partners in preventive veterinary care.

Thank you to all veterinarians, veterinary teams and students who helped celebrate. We hope you were able to engage with your clients and help cultivate the relationships that help keep animals healthy and happy.

We are thrilled with the success of this year’s Animal Health Week and look forward to celebrating another 30. Check out clinic celebrations by looking up #celebrateAHW on the CVMA Facebook or Twitter page.

John’s Veterinary Hospital shared a story on Facebook about how pet owners and veterinary care members were the perfect pair as they made a plan to minimize Hank’s stress for his veterinary visit. Note the green hue on Hank’s cheeks? He had a nice roll around in the grass before his clinic visit!

Durant la Semaine de la vie animale, la clinique St. John’s Veterinary Hospital a partagé une histoire qui illustrait pourquoi les propriétaires d’animaux et les membres de l’équipe vétérinaire sont des partenaires hors pair, tandis que le personnel planifiait comment minimiser le stress de Hank durant sa visite chez le vétérinaire. Voyez-vous la teinte verte sur les joues de Hank? Il a gambadé dans la pelouse avant sa visite à la clinique!

Olds College veterinary technical assistant student, Mishaela, celebrated Animal Health Week by adopting an adorable fur companion!

L’étudiante en techniques vétérinaires d’Olds College, Mishaela, a célébré la Semaine de la vie animale en adoptant un adorable compagnon à fourrure!

Inviting clients for a special cake and coffee day is just one of the ways the Torbay Road Animal Hospital celebrated Animal Health Week.

L’hôpital Torbay Road Animal Hospital a invité ses clients à savourer du gâteau et un café pendant l’une des nombreuses activités organisées pour célébrer la Semaine de la vie animale.

Look how great the Shawnessy South Pet Hospital team looked sporting their Animal Health Week T-shirts during their very successful open house!

Quelle belle photo de l’équipe de l’hôpital Shawnessy South Pet Hospital portant leur t-shirt de la Semaine de la vie animale durant une journée portes ouvertes très réussie!

The Perfect Pair: Partners in Preventive Veterinary Care
Récapitulation de la Semaine de la vie animale 2015

En octobre, la 30e Semaine de la vie animale de l’Association canadienne des médecins vétérinaires (ACMV) a connu un succès retentissant. Avec près de 200 cliniques et hôpitaux vétérinaires qui ont participé à l’événement, des milliers de familles d’un océan à l’autre ont été introduites au thème de cette année : «Des partenaires hors pair en matière de soins vétérinaires préventifs».

Merci à tous les vétérinaires, équipes vétérinaires et étudiants qui ont collaboré aux célébrations. Nous espérons que vous avez pu interagir avec vos clients et cultiver les liens qui contribuent à garder les animaux en santé et heureux.

Nous sommes ravis du succès de la Semaine de la vie animale de cette année et nous nous réjouissons à la pensée de célébrer cette semaine pendant trente autres années. Jetez un coup d’œil
Mark your calendar for the 2016 Animal Health Week campaign, which will take place from October 2 to October 8, 2016.

Of course, the CVMA could not have achieved this success without the support of our generous sponsors. We would like to graciously thank our 2015 Animal Health Week sponsors: Principal Sponsor, Petsecure Pet Health Insurance; Program Plus Sponsor, IDEXX Laboratories; and Program Sponsors, iFinance Petcard and Merial.

Please visit the website (www.canadianveterinarians.net) to learn more about the Canadian Veterinary Medical Association and Animal Health Week.

The Canadian Food Inspection Agency (CFIA) hosted the CVMA during Animal Health Week with presentations to the CFIA staff in Ottawa, Ontario on the importance of animal health for the health and well-being of animals, Canadians and Canada’s economy. In photo, from left to right: Dr. Jaspinder Komal, Executive Director, Animal Health Directorate; Dr. Harpreet Kochhar, Associate Vice President, Operations, CFIA and Canada’s Chief Veterinary Officer; Dr. Barry Stemshorn, CVMA treasurer; Dr. Andrea Ellis, Veterinary Science Advisor to the OIE Delegate; and Mr. Paul Mayers, Vice President, Policy and Programs.

L’Agence canadienne d’inspection des aliments (ACIA) a accueilli l’ACMV durant la Semaine de la vie animale dans le cadre de présentations devant le personnel de l’ACIA à Ottawa, en Ontario, sur l’importance de la santé animale pour la santé et le bien-être des animaux, des Canadiens et de l’économie du Canada. Dans la photo, de gauche à droite : Dr Jaspinder Komal, directeur exécutif, Direction de la santé animale; Dr Harpreet Kochhar, vice-président associé, Opérations de l’ACIA, et vétérinaire en chef du Canada; Dr Barry Stemshorn, trésorier de l’ACMV; Dr Andrea Ellis, conseillère en sciences vétérinaires auprès de la déléguée de l’OIE; et M. Paul Mayers, vice-président, Politiques et programmes.

The Green Acres Animal Hospital invited clients to come and take a photo of their pet for a chance to win this fantastic gift basket as part of their Animal Health Week celebrations!

La clinique Green Acres Animal Hospital a invité ses clients à venir prendre une photo de leurs animaux pour courir la chance de gagner cet épatant panier-cadeaux dans le cadre de ses célébrations de la Semaine de la vie animale!
This past summer, we spent 10 weeks interning on a dairy program through Veterinarians Without Borders–Canada (VWB-Canada) in the central Kenyan highlands. VWB-Canada has partnered for years with the non-governmental organization (NGO) called Farmers Helping Farmers (based in Prince Edward Island) to improve human livelihoods among smallholder dairy farms using principles of environmentally friendly and socially responsible sustainable development.

Under the supervision of PhD student Dr. Shauna Richards and professor John VanLeeuwen of the Atlantic Veterinary College, we had a number of activities during the summer: 1) we worked on 2 research projects collecting data from study farms; 2) we educated farmers (primarily women) on evidence-based best management practices, informed by previous applied research results in Kenya; and 3) we taught One Health concepts in local schools, given the close interconnectedness among animals, people and the environment on these farms. We taught how to recognize and prevent the spread of disease in animals and people, using specific zoonotic disease examples such as rabies, brucellosis, and diarrheal diseases.

The cow comfort and welfare research project focused on determining how changes to stall design and management would lead to reduced mastitis rates and increased lying down times and milk yields. We worked with farmers to make practical and inexpensive changes, such as adjusting improperly placed neck...
Le projet de recherche sur le confort et le bien-être des vaches portait sur la façon dont la modification de la conception des stalles et de la gestion produirait des taux réduits de mammite ainsi qu'une augmentation de la durée du coucher et de la production de lait.

Nous avons travaillé avec les fermiers pour mettre en œuvre des changements pratiques et économiques, comme l’ajustement des barres de cou mal placées afin que les vaches puissent utiliser les stalles plus efficacement. Les résultats positifs ont aidé beaucoup de fermiers à réaliser l’importance de l’amélioration du bien-être de leurs vaches.

Le projet de recherche sur la nutrition des vaches a porté sur la façon dont les concentrés laitiers et le mélange de minéraux amélioraient la production du lait et la reproduction et comment des fourrages locaux de grande qualité (comme l’herbe à éléphant ou les feuilles de patate douce) pouvaient servir de substitut à certains concentrés laitiers dispendieux tout en réduisant l’érosion du sol. Nous avons observé par nous-mêmes comment la formation des fermiers à propos de ces informations avait un impact incroyable sur la santé, le bien-être et la productivité des vaches.

Pour toutes les connaissances que nous avons transmises, nous avons reçu 10-fold in return as they made us feel like part of the community. No visit to a farm was complete without the farmer offering us sweet milky chai (Swahili for tea), fruit, great hospitality, and conversation. The whole experience has reinforced how privileged we are to attend veterinary college. Having had the opportunity to use our veterinary knowledge for the benefit of others who truly need it in the beautiful Kenyan countryside has been nothing short of amazing.

(by Sarifa Lakhdhir, UCVM Class of 2018; Maggie Grover, UCVM Class of 2017; and Mira Kelada, WCVM Class of 2016.)
Your CVMA Membership Means More... Introducing Plumb’s Veterinary Drugs™

Votre adhésion à l’ACMV vous offre un nouveau service... grâce à l’introduction de Plumb’s Veterinary Drugs™

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In this issue of The CVJ, Quebec members will find inserted a Call for Nominations form for the upcoming election of a Council member to represent CVMA members in Quebec. Deadline for submission of the form is December 10, 2015. If more than one candidate is nominated, a description of the candidates will be emailed to all Quebec members the week of December 14, 2015.

Dans le présent numéro de La RVC, les membres du Québec trouveront un formulaire d’Appel de mises en candidatures pour l’élection prochaine pour un membre du conseil représentant les membres de l’ACMV au Québec. La date limite pour soumettre le formulaire est le 10 décembre 2015. S’il y a plus d’une mise en candidature, une description des candidat(e)s sera envoyée par courriel à tous les membres de l’ACMV au Québec la semaine du 14 décembre 2015.
From the Students of the Canadian Veterinary Medical Association (SCVMA)

Before becoming a SCVMA representative for the Faculté de médecine vétérinaire, I knew very little about the CVMA, the benefits of membership and, most of all, the fact that our opinion, yes, the opinion of veterinary students across Canada, is valuable to the CVMA Council. Are you surprised? Let me explain.

The SCVMA Committee includes a representative from each veterinary college in Canada and each representative is given one of the following roles: SCVMA president, Symposium coordinator, coordinator of the annual student newsletter VetRap, coordinator of the annual New Graduate Survey and, lastly, editorial coordinator of student articles for The Canadian Veterinary Journal (The CVJ). Each role rotates between the 5 colleges. The SCVMA Committee meets in-person twice a year, once during the Symposium in January and once during the CVMA Convention in July and hosts 2 teleconferences, one in October and one in March. The goal of these meetings is to provide a forum for veterinary student representatives, and to allow for the exchange of ideas and information within the profession and the CVMA. That is where the SCVMA president’s role comes into play, as the SCVMA president is also a member of the CVMA Council serving as a liaison between the SCVMA Committee and the CVMA Council. The president can attend all 3 Council meetings and has the right to vote, as a spokesperson for Canadian veterinary students! This year, our SCVMA president is Justin Kristjansson from the Western College of Veterinary Medicine in Saskatoon, Saskatchewan.

Now, let’s talk about some of the benefits of being a Student of the CMVA. The CMVA provides lab coats and name badges to every first-year student and gives every student a monthly complimentary print edition of The Canadian Veterinary Journal during the school year. Students from each college can also attend the “One Voice” presentation, given by a CMVA representative, to learn more about what the CMVA does for you and for the profession. After the One Voice presentation, a “hot topic” discussion takes place. This year’s debate was lively and interesting as we examined the CMVA’s position on cosmetic alteration such as ear and tail cropping, as well as declawing. CMVA membership offers a host of benefits and for more information; you can visit the CMVA website (www.canadian-veterinarians.net).

Also, new this year, students who maintain uninterrupted membership after graduation throughout a consecutive 3-year period are eligible for discounted annual membership dues (AMD) reduction as follows:

- **Year of graduation**: Complimentary half-year membership (July–December).
- **Year 1 after graduation**: 75% reduction of the regular AMD, plus a complimentary continuing education voucher for the CVMA Convention.

Message des Étudiants de l'Association canadienne des médecins vétérinaires (ÉACMV)

Avant que je ne devienne représentante étudiante des ÉACMV pour la Faculté de médecine vétérinaire de l’Université de Montréal, j’avais très peu de connaissances sur l’ACMV, les avantages d’en être membre et surtout du fait que notre opinion, oui celle des étudiants en médecine vétérinaire du Canada, a de la valeur et est écoutée au Conseil de l’ACMV. Vous êtes surpris? Laissez-moi vous expliquer!

Le Comité des ÉACMV est formé d’un représentant de chaque faculté canadienne en médecine vétérinaire, et chaque représentant est mandaté d’un des 5 rôles suivants : président des ÉACMV, président du Symposium annuel des ÉACMV, coordonnateur du Vet Rap annuel, coordonnateur du sondage annuel des finissants et enfin coordonnateur editorial (RVC). Chaque rôle est attribué par rotation au sein des 5 écoles. Le Comité des ÉACMV se rencontre en personne deux fois par année, une fois pendant le Symposium en janvier et une fois pendant le congrès de l’ACMV en juillet, et il organise deux téléconférences, une en octobre et une en mars. Le but de ces rencontres consiste à servir de forum pour les représentants des étudiants en médecine vétérinaire et de permettre l’échange d’idées et d’information au sein de la profession et de l’ACMV. Et c’est là que le rôle du président des ÉACMV prend tout son sens, car le président des ÉACMV est aussi membre du Conseil de l’ACMV et il effectue la liaison entre le Comité des ÉACMV et le Conseil de l’ACMV. Le président peut assister aux trois rencontres du Conseil et a le droit de vote, en tant que porte-parole de la communauté étudiante canadienne! Cette année, notre président des ÉACMV est Justin Kristjansson du Western College of Veterinary Medicine à Saskatoon.

Parlons maintenant des avantages d’être membre de l’ACMV en tant qu’étudiant. L’ACMV présente un sarrau et un insigne d’identité à tous les étudiants de première année et vous offre gratuitement un exemplaire mensuel de La Revue vétérinaire canadienne pendant l’année universitaire. Les étudiants de toutes les écoles peuvent aussi assister à la présentation «Une voix», qui est donnée par un représentant de l’ACMV, pour en apprendre davantage à propos du travail de l’ACMV pour vous et la profession. Après la présentation Une voix, une discussion a ensuite lieu sur un sujet «brûlant». Cette année, le débat a été animé et intéressant, car nous avons examiné la position de l’ACMV sur les chirurgies esthétiques telles que la coupe de queue et d’oreilles ainsi que le dégriffage. L’adhésion à l’ACMV offre une foule d’autres avantages et, pour plus d’informations, vous pouvez consulter le site Web de l’ACMV (www.veterinairesaupu.com).  

De plus, pour la première fois cette année, les étudiants qui conservent l’adhésion sans interruption pendant une période consécutive de trois ans après l’obtention du diplôme seront admissibles à une réduction de la cotisation annuelle selon le calendrier suivant :

- **Année d’obtention du diplôme** : Adhésion gratuite pendant la moitié de l’année (de juillet à décembre).
Year 2 after graduation: 50% reduction of the regular AMD.
Year 3 after graduation: 25% reduction of the regular AMD.

Lastly, we are proud to announce that the 30th SCVMA Symposium, “The Elephant in the Room,” will be held January 15 and 16 at the Ontario Veterinary College in Guelph, Ontario. This event, organized by students for students, hosts lectures, tours and wet labs not to mention great social events where you can meet veterinary students from across Canada! We hope to see you there!

On behalf of Canadian veterinary students, I thank the CVMA for all the benefits and support that they offer us during our studies as well the warm welcome to the profession!

(by Hélène Rembeaux, editorial coordinator, SCVMA)

Pet Nutrition Assessment Video: Feline Focus

“Making a nutritional recommendation for every pet is the key”

A pet nutrition assessment video, created by the Canadian Veterinary Medical Association (CVMA), suggests including nutrition in the criteria that are evaluated during a regular veterinary examination to maintain optimal pet health.

The video breaks down the feline nutritional assessment process in 3 easy steps, and highlights a relatively new process called muscle condition scoring to assess muscle mass rather than body fat.

You can visit the CVMA’s YouTube Channel to view the video. Support for the video was provided by Hill’s Pet Nutrition Canada Inc., P & G Pet Care and Nestle Purina.

The CVMA is a member of the Pet Nutrition Alliance, which is comprised of a number of veterinary organizations that are working together to promote the importance of nutrition in the health of pets worldwide. Visit the website (www.petnutritionalliance.org/) to learn more.

«Il est essentiel de présenter une recommandation de nutrition pour chaque animal de compagnie.»

Une vidéo sur l’évaluation de la nutrition des animaux de compagnie, qui a été produite par l’Association canadienne des médecins vétérinaires (ACMV), suggère l’inclusion de la nutrition dans les critères qui sont évalués durant un examen vétérinaire régulier afin d’assurer une santé optimale pour les animaux de compagnie.

La vidéo décompose le processus d’évaluation nutritionnelle des chats en trois étapes faciles et elle souligne un processus relativement nouveau appelé «note d’état musculaire» qui permet d’évaluer la masse musculaire plutôt que la graisse corporelle.


L’ACMV est membre de la Pet Nutrition Alliance, qui se compose de plusieurs organisations vétérinaires travaillant ensemble pour promouvoir l’importance de la nutrition pour la santé des animaux de compagnie partout dans le monde. Visitez le site Web (www.petnutritionalliance.org/) pour en apprendre davantage.

Dr. Susan Little demonstrates the proper steps to conduct a feline nutrition assessment.

La Dr. Susan Little fait une démonstration des étapes appropriées pour réaliser une évaluation de la nutrition des chats.
As I write this my term as president of the Nova Scotia Veterinary Medical Association (NSVMA), is winding down. It has been a great experience working with the NSVMA over the past several years.

At the time of writing, the NSVMA office was preparing for the Annual General Meeting (AGM) that will have been held near the end of October. For the past several years the AGM had taken place at the beautiful seaside Oak Island Inn, a spectacular setting of unspoiled nature, with a history of buried treasure on Nova Scotia’s south shore. This year’s AGM was different and exciting as we welcomed the Registered Veterinary Technologists (RVT) to the association. This is the first year that the RVTs will be full members of the NSVMA and have all the privileges associated with it. Since the legislation has passed, approximately 130 new RVTs have joined the NSVMA.

Our AGM weekend also provided members with a continuing education opportunity, this year it was Dr. Gary Landsburg who spoke about “Fear Free Visits” and the “Aging Brain.” This is the 2nd year we had a trade show at the AGM weekend, giving us a chance to interact with some of our sponsors and industry representatives. Prior to the AGM there was a new member orientation to welcome them and to make them aware of what the NSVMA is, what we do, and how they can get involved. At the AGM itself we heard from the dean of the Atlantic Veterinary College, a representative from the Department of Agriculture, committee reports were given and the annual NSVMA Awards were handed out. After the AGM there was a dinner, entertainment and a great chance to mingle with colleagues and new members. The evening also included a boisterous live charity auction; the auction items were donated by members to raise money for Feed Nova Scotia.

Over the past year the NSVMA has been working with the Nova Scotia College of Chiropractors on a policy describing what qualifications are required for one of their members to become certified in animal chiropractic with the privilege of working on animals. The objectives of the policy are to promote professionalism, safety and effectiveness in the chiropractic care of animals. We are excited to have this collaboration between the 2 professions.

This year there was legislation passed by the provincial government that a veterinary health certificate must be filled out by a veterinarian prior to any pet being sold. The NSVMA government that a veterinary health certificate must be filled by a veterinarian prior to any pet being sold. The NSVMA

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This year there was legislation passed by the provincial government that a veterinary health certificate must be filled out by a veterinarian prior to any pet being sold. The NSVMA
supported this and hopes it will deter the sale of unhealthy or poorly cared for pets.

For the past several years the NSVMA has met with representatives from the provincial Department of Agriculture and have increased its lines of communication, it is hoped this will continue and be built upon. The topics that we feel are currently relevant to discuss with the Department of Agriculture are forming a rabies working group, continuing to improve lines of communication, and to make veterinarians more aware of the provincial pathology laboratory in Truro, Nova Scotia.

Currently we are working on implementing a mandatory course that would educate our members on antimicrobial resistance. We are pleased that the CVMA is creating awareness around this timely topic and feel that it is a significant global concern and that veterinarians can play an important role regarding this issue.

I was very fortunate to have the opportunity to attend the CVMA Convention in Calgary, Alberta. I enjoyed meeting and networking with other veterinarians from across Canada, and especially enjoyed the president's meeting and hearing of the work the other provincial associations are undertaking. The Calgary Convention was very hospitable. I was fortunate to be able to camp for 3 nights in majestic Banff National Park after the conference was over.

I encourage veterinarians to get involved with their provincial association and/or the CVMA. I learned a great deal from Dr. Frank Richardson who is the long-standing registrar of the NSVMA. I found my time on the NSVMA executive a memorable experience and was fortunate to work with many talented and knowledgeable individuals, and I have grown to appreciate how broad the veterinary profession is in Nova Scotia.

(by Jane Corkum, President, Nova Scotia Veterinary Medical Association)

Around the Provinces is a regular news feature in The Canadian Veterinary Journal designed to inform Canadian veterinarians about the work of provincial veterinary associations across Canada. We invite the provincial presidents of these associations to report on the activities and issues being addressed by their respective organizations. We thank Jane Corkum for her article in this issue. CVJ eds.

Le tour des provinces est une chronique régulièrement publiée dans La Revue vétérinaire canadienne afin d’informer les vétérinaires du Canada sur le travail des associations vétérinaires provinciales. Nous invitons les présidents de ces associations à nous faire part des activités et des enjeux de leurs organismes respectifs. Nous tenons à remercier Jane Corkum pour son article. Les rédacteurs de la RVC.
Intraoperative acridine orange photodynamic therapy and cribriform electron-beam irradiation for canine intranasal tumors: A pilot study

Takuya Maruo, Koichi Nagata, Yasuhiro Fukuyama, Yuki Nemoto, Shinpei Kawarai, Yukihiro Fujita, Tomohiro Nakayama

Abstract — Untreated canine intranasal tumors carry a poor prognosis. We retrospectively evaluated the efficacy of marginal tumor resection in combination with intraoperative acridine orange (AO) photodynamic therapy (PDT) and 1 fraction of 5 Gy megavoltage irradiation for canine intranasal malignant tumors. When cribriform plate invasion or turbinate destruction around the cribriform plate was present, an additional fraction of 20 Gy was delivered with an electron beam during surgery. The study included 6 dogs, 2 of which were classified as stage I, 1 as stage II, and 3 as stage IV. The median local disease-free survival time and overall survival after the treatment were 8.5 and 13 months, respectively. Recurrence was noted in 2 of the 6 dogs after 4 and 7 months. Adverse events were mild (subcutaneous emphysema in 1 case, and rhinitis in 3 cases). Combination AO therapy may increase the tumor control time of dogs with marginally resectable intranasal malignant tumors.

Résumé — Pour des tumeurs intra-nasales malignes, une thérapie photodynamique administrant de l’acridine orange pendant l’opération et une irradiation par mégavoltage aux plaques cribriforms: l’étude préliminaire. Le pronostic des tumeurs intra-nasales canines non traitées est défavorable. Cette étude avait pour objectif d’évaluer rétrospectivement l’efficacité de la résection marginale d’une tumeur associée à une thérapie photodynamique (TPD) administrant de l’acridine orange (AO) pendant l’opération et à 1 fraction de 5 Gy d’irradiation par mégavoltage dans le traitement des tumeurs intra-nasales malignes. En cas d’invasion des plaques cribriformes et/ou de présence de cornets autour des lésions cribriformes, une fraction supplémentaire de 20 Gy a été administrée pendant l’opération par faisceaux d’électrons. Six chiens ont été inclus dans l’étude. Deux chiens présentaient des tumeurs de stade I, un de stade II et trois de stade IV. La durée moyenne de survie sans récidive locale et de survie globale après le traitement étaient respectivement de 8,5 et 13 mois. Une nouvelle tumeur est apparue chez deux des six chiens, respectivement 4 et 7 mois après le traitement. Les effets indésirables étaient bénins (un cas d’emphysème sous-cutané et trois cas de rhinite). L’association de la thérapie par AO améliorerait la durée de contrôle de la tumeur chez les chiens présentant des tumeurs intra-nasales malignes marginalement résecables.

(Traduit par les auteurs)

Can Vet J 2015;56:1232–1238

Introduction

Canine intranasal tumors are typically seen in older dogs and are usually locally aggressive but associated with a low metastatic rate (1,2). External beam radiation therapy (EBRT) is considered the most effective treatment for canine nasal tumors (1). Canine intranasal tumors that are not treated by radiation are associated with a poor prognosis (3). Without treatment, survival times range from 0.9 to 5.5 mo depending on the clinical stage at the time of diagnosis (4–8). Median survival time after surgery alone is 3 to 6 mo, similar to that without treatment (2). Median survival time ranges from 11 to 19.7 mo in dogs treated with megavoltage irradiation (2). Surgery has been combined with radiotherapy in an attempt to prolong survival time for canine intranasal tumors (5,8–12). Thirteen dogs that received accelerated radiotherapy followed by surgery had a median survival of about 4 y (9).

Photodynamic therapy (PDT) involves a photosensitizer, photons (usually visible light), and oxygen. Administration of a photosensitizer to a patient (either topically or intravenously)
followed by application of visible light leads to a photochemical reaction between photosensitizer and oxygen, resulting in highly reactive singlet oxygen molecules (13–15). Antitumor effects of PDT involve direct tumor cytotoxicity, damage to the tumor vasculature, and inflammation which could lead to development of systemic immunity (14). Photodynamic therapy is rarely used against cancer in veterinary medicine (13), presumably due to the cost of equipment.

Acridine orange (AO) is a photosensitizing agent used for PDT in humans, rodents, and a cat (16–20). Acridine orange has maximum absorption at 497 nm (21), and can diffuse into the cytoplasm of cells within a few seconds. Acridine orange is basic and binds to acidic structures such as DNA, RNA, lysosomes, and other acidic vesicles (16). Excited by photon energy from visible light or X-ray, AO produces reactive singlet oxygen molecules (16,19,21) and selectively accumulates in malignant tissue, such as epithelial tumors (17) and sarcomas (19,21). This is not surprising, since tumor microenvironment is often acidic due to increased production of lactate (22). Acridine orange is non-carcinogenic for humans (class 3) (16). Mice with epithelial tumors treated with oral AO and argon laser had partial or complete necrosis of the tumors (17). Rats with implanted gastric tumors treated with intraperitoneal AO and argon laser also had partial or complete necrosis of the tumors (18). In both studies, surrounding normal tissues showed minimal toxicity (17,18).

In humans, intra-lesional AO-PDT or partial tumor excision followed by AO-PDT using xenon visible light combined with 1 fraction of 5 Gy megavoltage irradiation has been used to treat musculoskeletal sarcomas (19,23). Therefore, we sought to determine if this approach was suitable for the treatment of intranasal tumors in dogs.

The secondary objective was to assess its effectiveness.

**Materials and methods**

**Case selection**

Six dogs with marginally resectable intranasal tumors that were treated by surgical resection with intraoperative AO-PDT between October 2010 and September 2013 at Azabu University Veterinary Teaching Hospital were selected. Dogs that had radiation therapy before the procedure were excluded from the study. Information obtained from the medical records (or from telephone interviews with the owner or referring veterinarian) included breed, gender, age, body weight, tumor stage at the time of initial diagnosis, the status (i.e., intact versus destroyed) of the TAC, histopathological diagnosis, treatment methods [i.e., whether a marginal resection AO-PDT, or cribriform irradiation were performed, and other information regarding radiation treatments (cone size, gantry angle, beam energy in MeV, and prescribed dose)], side effects, recurrence, methods used to detect tumor recurrence, local disease-free interval, and overall survival.

**Staging of tumors**

Tumor stage at the time of initial diagnosis was based on the staging method described by Adams et al (25), and the status of TAC was assessed by computed tomography (CT) images.

**Assessment of side effects**

Side effects were assessed by physical examinations during hospitalization, at the time of suture removal (1 to 2 wk after surgery), and at the time of follow-up rechecks. The schedules of the follow-up rechecks were not standardized. If follow-up rechecks were not done at Azabu University, telephone interviews were conducted with the owner or the referring veterinarian. Radiation side effects were scored based on the Veterinary Radiation Therapy Oncology Group (VRTOG) classification (26).

**Treatment planning**

Prior to surgical debulking, the extent of the tumor was evaluated using CT images (Asteion (a 4-slice helical scanner), Toshiba, Tokyo, Japan) encompassing the entire skull. Surgical planning was aided by the information obtained from the CT images. For radiotherapy, a 3D planning software package (XiO; Elekta K. K., Tokyo, Japan) was used. The tumor that was visible on the CT images was defined as the gross tumor volume (GTV). The clinical target volume (CTV) and the planning target volume (PTV) were not defined, because a board-certified radiation oncologist was not available at the time of treatment. The field margins were set at 1 cm outside the margin of the GTV. A 6-MV linear accelerator (Primus; Toshiba Medical System, Tokyo, Japan) was used for X-ray irradiation.

**Surgical removal of the tumor**

The skin incision was made 5 mm beyond the rostral and caudal extents of the tumor. A chisel was used to remove the bone and
to expose the nasal cavity. The periosteum was separated from the bone and was sutured back to the bone after the procedure. If the tumor had gross invasion into the bone, the affected bone and the associated periosteum were permanently removed. The tumor and surrounding mucous membrane were removed using suction and curettage until the bone was exposed (Figure 1A).

**Acridine orange — photodynamic therapy (AO-PDT)**

We then performed AO-PDT on the residual tumor bed. Acridine orange hydrochloride (Sigma-Aldrich, St. Louis, Missouri, USA), stock solution, 10 mg/mL in H₂O, was sterilized by filtration through a membrane filter (25AS020AS; Advantex MFS, Dublin, California, USA). The surgical site was packed with gauze soaked with AO solution (1 μg/mL AO in saline) for 5 min (16). This was followed by exposure of the tumor bed to unfiltered xenon light (Xenon nova 175; Karl Storz Endoscopy Japan K. K., Tokyo, Japan) for 10 min. The parameters associated with this light source are: 175 watt, 12.5 volt, 14 amp, 5800 Kelvin, and 2200 lumens. The approximate range of wavelength of the xenon light was 400 to 700 nm, and the power density was 20.7 mW/cm² at a distance of 10 cm from the light source, which was the distance between the light source and the tumor bed during AO-PDT. The quoted power density was measured using a spectro-radiometer (USR-45DA-14, Ushio, Tokyo, Japan).

**Electron beam irradiation in select cases**

Three dogs (cases 2, 4, 6) had both TAC and cribriform destruction, thus they received a supplementary electron-beam irradiation treatment (Primus; Toshiba Medical System, Tokyo, Japan) with 20 Gy (Figure 1B). The treatment was performed with a 2-cm cone. Beam energies used for the treatments ranged from 5 to 12 MeV, depending on the estimated depth of the tumor. A bolus (approximately 0.5-cm thick wet gauze soaked with saline) was used for all cases. Dose was prescribed to the 90% isodose line. Electron beam irradiation was administered immediately after AO-PDT (i.e., before skin closure) (Figure 1C).

**Radiodynamic therapy**

After the skin was closed at the end of surgery, an additional X-ray irradiation (5 Gy) was performed in all 6 cases. One-centimeter thick tissue-equivalent bolus (MTCB 410 S, CIVO Medical Solutions, Kalona, Iowa, USA) was placed on the patient to cover the entire radiation field in all patients.

**Procedures after treatment**

Immediately after the combination treatment described, another CT scan was performed in all 6 cases to obtain baseline images that could be used to compare with images taken during the follow-up visits. Fentanyl citrate (Fentanyl Injection; Janssen Pharmaceutical K. K., Tokyo, Japan), 1 to 2 mg/kg body weight (BW) per hour, IV, was administered for postoperative pain until the morning of the day after surgery. The dogs were discharged on the day after surgery, and were prescribed piroxicam (Baxo; Toyama Chemical, Tokyo, Japan), 0.3 mg/kg BW, PO, q24h, for 1 wk for pain management. Cephalexin (Larixin; Toyama Chemical), 20 to 30 mg/kg BW, PO, q12h, was also administered to all dogs for 1 wk after surgery.

**Systemic administration of AO in 1 dog**

In case no. 2, the owner gave consent for IV administration of AO, and the dog was administered sterilized AO at 0.1 mg/kg BW, IV, 15 min before the induction. Systemic administration of AO was approved by the Animal Research Committee of Azabu University (No. 120921-2). Intravenous AO was administered to this dog because the authors thought that this might sensitize cells better than soaking the superficial cells with AO solution. In addition to IV AO, this dog also had the tumor bed soaked with gauze soaked with AO, similar to the other dogs. Intravenous administration was not performed in the other dogs due to owners’ concerns. The authors did not instruct any of the 6 owners to keep their dogs...
from sunlight after the treatment, because a previous study by one of the authors, showed that none of 5 dogs that were treated with AO, 0.1 mg/kg BW, IV, showed generalized photosensitivity (27).

Statistical analysis
The median local disease-free interval and overall survival were calculated from the Kaplan-Meier survival curve using JMP statistical software (version 8.02; SAS Institute, Cary, North Carolina, USA). Local disease-free interval was defined as the time from the time of the combination treatment described herein to the time of local recurrence. Survival time was defined as the time from the treatment to the time of death. Dogs were not censored if there was a tumor recurrence or if they died without a tumor recurrence.

Results

Patient characteristics
The breeds included in this study were Labrador retriever, beagle, golden retriever, miniature dachshund, Shiba Inu, and Pembroke Welsh corgi. Three dogs were male (1 castrated), and 3 were female (2 spayed). The median age was 11.5 y (range: 10 to 13 y), and the median body weight was 13.0 kg (range: 9.5 to 31.5 kg). The tumor stage at the time of initial diagnosis was stage I in 2 dogs, stage II in 1 dog, and stage IV (i.e., presence of cribriform destruction) in 3 dogs. The TAC was intact in 2 dogs and destroyed in 4 dogs. The following tumor types were identified: adenocarcinoma (\( n = 3 \)), transitional carcinoma (\( n = 1 \)), undifferentiated carcinoma (\( n = 1 \)), and chondrosarcoma (\( n = 1 \)). Tumor characteristics are summarized in Table 1.

Side effects and recurrence
Three dogs (cases 2, 3, 5) were rechecked every month for a few months after surgery. Two dogs (cases 1, 6) did not come back to Azabu University for rechecks, so the dogs’ referring veterinarians were interviewed by telephone at 8 and 3.5 mo after surgery, respectively. The remaining dog (case 4) was not rechecked until the dog was brought back to Azabu University 10 mo after the treatment for a recheck CT scan. Signs indicative of photosensitivity (such as skin rashes) were not reported in any of the 6 dogs. Adverse events were mild (subcutaneous emphysema in dog 2 and rhinitis in dogs 2, 4, and 5). Radiation side effects were not detected in any of the dogs during the study period, although rhinitis might have been related to the irradiation (X-ray and/or the electron beam). Recurrence was noted in 2 of the 6 dogs, cases 1 and 2, after 4 and 7 mo, respectively. The methods of detecting recurrence were orthogonal radiographs in dog 1 and a CT scan in dog 2. Absence of recurrence was confirmed by a CT scan performed 10 mo after the treatment in dog 4. Two other dogs were considered to be recurrence-free, based on the absence of clinical signs (cases 5 and 6) and clearance of clinical signs post-surgery by antibiotics in 1 dog (case 3). In dog 1, the tumor recurred near the cribiform plate. This dog had an intact cribiform plate on the initial planning CT, but the TAC had already been destroyed at that time. In dog 2, recurrence was detected by CT 4 mo after the treatment. The recurrence was noted at the base of the first premolar, which led to a loss of this tooth (the tooth had been already lost at the time of the second CT). This dog also underwent magnetic resonance imaging (MRI) 7 mo after the treatment, which showed a recurrent tumor that was not contacting the cribiform plate.

Local disease-free time and overall survival time
The median local disease-free survival time was 8.5 mo (Figure 2A). The median overall survival was 13 mo (Figure 2B). Outcome data are summarized in Table 2.

Discussion
Several drugs, including pyropheophorbide-a-hexyl ether (28) and benzoporphyrin derivative monoacid ring-A (29), have been used for PDT of canine intranasal tumors. Lucroy et al (28) reported that clinical signs were controlled for variable lengths of time, with long-term responses achieved in 2 of 4 animals (at least 54 wk in 1 dog and at least 40 wk in 1 cat) that were treated with PDT multiple times. Osaki et al (29) reported that the 1-year survival rate of 7 dogs with intranasal tumors receiving Benzoporphyrin Derivative Monoacid Ring-A was 57%; however, 50% of the dogs developed nasocutaneous or oronasal fistulae (29). In the present report, median survival was 13 mo, and recurrence was noted in 2 of 6 dogs. Although direct comparisons cannot be made, disease-free survival in our study seems to be comparable to that described in the studies by Lucroy et al (28) and Osaki et al (29). Thus, the procedure described herein may be useful in treating dogs with marginally resectable intranasal tumors.

Acridine orange — photodynamic therapy appeared to be safe and was associated with a low incidence of mild side effects. Generalized cutaneous photosensitization is a well-known side effect of PDT, although its risk depends on the type of photosensitizer used. Compared with humans, cutaneous photosensitization has not been reported frequently in veterinary patients.

Table 1. Summary of tumor characteristics

<table>
<thead>
<tr>
<th>Case number</th>
<th>Breed</th>
<th>Tumor type</th>
<th>Tumor stage (29) at the time of initial diagnosis</th>
<th>TAC</th>
<th>Cribriform irradiation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Shiba Inu</td>
<td>Adenocarcinoma</td>
<td>1</td>
<td>Destroyed</td>
<td>Not performed</td>
</tr>
<tr>
<td>2</td>
<td>Beagle</td>
<td>Transitional carcinoma</td>
<td>4</td>
<td>Destroyed</td>
<td>0°, 12 MeV, 20 Gy</td>
</tr>
<tr>
<td>3</td>
<td>Labrador retriever</td>
<td>Adenocarcinoma</td>
<td>1</td>
<td>Intact</td>
<td>Not performed</td>
</tr>
<tr>
<td>4</td>
<td>Golden retriever</td>
<td>Undifferentiated carcinoma</td>
<td>4</td>
<td>Destroyed</td>
<td>45°, 5 MeV, 20 Gy</td>
</tr>
<tr>
<td>5</td>
<td>Miniature dachshund</td>
<td>Chondrosarcoma</td>
<td>2</td>
<td>Intact</td>
<td>Not performed</td>
</tr>
<tr>
<td>6</td>
<td>Pembroke Welsh corgi</td>
<td>Adenocarcinoma</td>
<td>4</td>
<td>Destroyed</td>
<td>0°, 10 MeV, 20 Gy</td>
</tr>
</tbody>
</table>

TAC — status of nasal turbinate around the cribriform plate.
This may be because Photofrin (first generation photosensitizer that readily causes cutaneous photosensitization) has not been used commonly in veterinary medicine. Also, it may be due to differences in the structures of the skin, and the pattern of distribution of photosensitizer in the tissues of humans and animals (30). Other side effects such as hepatotoxicity, hyperemia, edema, cyanosis, and pruritus have also been observed after systemic administration of a photosensitizer in veterinary patients (13). Importantly, photosensitivity with systemic AO administration has not been reported in mice (17), humans (31), or dogs (27). No side effects were reported in humans (19,32), or a cat (20) in which AO solution was applied at the surgical site. In this report, cutaneous photosensitivity reactions were not detected in any case. Rhinitis and subcutaneous emphysema were likely related to surgery, X-ray, or electron beam irradiation (or a combination of these) rather than to the direct effect of AO. Late side effects might have been observed in cases that received electron irradiation if the follow-up periods had been longer. Intravenous administration of AO may help sensitize more tumor tissue, thus, IV administration (as well as topical administration) of AO as a PDT/radiation sensitizer warrants further evaluation. Irradiation did not seem to inhibit wound healing significantly, possibly due to use of only 1 fraction of 5 Gy megavoltage irradiation and selective accumulation of AO to malignant tissue.

An additional electron beam irradiation to the cribriform plate may be useful in controlling residual tumor around the cribriform plate, since recurrence around the cribriform plate was not detected following the electron beam treatment in 3 dogs that had stage IV tumors. The addition of intraoperative electron-beam irradiation may be a useful strategy, especially when there is cribriform invasion and/or TAC, since high-energy electron beams can penetrate deeper into tissue than the visible-light photons used for PDT. Destruction of the cribriform plate has been described as a negative prognostic factor in dogs with intranasal tumors treated by radiation therapy (25). In cases in which the cribriform plate was destroyed, the median survival time was only 5 to 7 mo after radiotherapy (25,33–35). From the authors’ experience, the gross tumor located in the TAC can be difficult to remove completely. This likely accounts for the recurrence of the tumor in this location in dog 1. Thus, the authors recommend a careful inspection of

<table>
<thead>
<tr>
<th>Case number</th>
<th>Method of detection</th>
<th>Local disease-free interval (mo)</th>
<th>Side effects</th>
<th>VRTOG Late morbidity classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Radiographs</td>
<td>7</td>
<td>ND</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>CT</td>
<td>4</td>
<td>Subcutaneous emphysema, rhinitis</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Response to antibiotics</td>
<td>No recurrence. Died 8.5 mo after treatment</td>
<td>Rhinitis</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>CT</td>
<td>&gt; 10</td>
<td>Rhinitis</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>No clinical sign</td>
<td>&gt; 10</td>
<td>ND</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>No clinical sign</td>
<td>&gt; 3.5</td>
<td>ND</td>
<td>0</td>
</tr>
</tbody>
</table>

VRTOG — Veterinary Radiation Therapy Oncology Group scoring system; ND — not detected; CT — computed tomography; PDT — photodynamic therapy; AO — acridine orange. * An MRI performed 7 mo after PDT revealed recurrence of the tumor not involving the cribriform, which was destroyed at the time of AO-PDT. * Death was unrelated to the tumor. The dog did not show recurrence.

Figure 2. A – Kaplan-Meier survival curve of local disease-free survival. B – Kaplan-Meier survival curve of overall survival.
the TAC if the technique described herein is used, even for dogs with stage I tumors.

The strategy in the present study has an advantage over daily, full-course radiation therapy, because the former involves only one treatment session, as opposed to multiple treatments with the latter. Dog 2, which received IV AO, did not show any noticeable side effects. This dog had an early recurrence of the tumor (4 mo after AO), but this may not be necessarily from a lack of efficacy of intravenous administration of AO, since this dog had cribriform destruction at the time of the treatment, which suggests that the tumor might have been aggressive. Also, the recurrence was noted at the base of the first premolar, which suggests that the tumor might have been aggressive. Also, the recurrence was noted at the base of the first premolar, suggesting that this tumor may have had microscopic invasion to this area at the time of treatment and had been treated suboptimally. As far as the authors know, there are no published data regarding the degree of penetration of AO applied as a gauze soaked with AO, although a study by Kusuzaki et al (19) states that “AO invades deeper tissues quickly at the rate of 1 cm per hour (unpublished data).” Although the lipophilic AO readily permeates cell membranes, the degree of penetration following local application is likely affected by multiple factors including the type of tissue and the duration of application. We hypothesized that AO would permeate throughout the tumor better if applied both locally and intravenously. The safety of intravenous AO administration has been assessed in mice and dogs (27,36).

Interestingly, AO emits green fluorescence, detectable by a fluorescence surgical microscope. Because AO preferentially accumulates in malignant tissue, tumors can be visualized by this method (fluorovisualization effect) (16,19). Unfortunately, this microscope was not available. The fluorovisualization effect could have led to detection of residual tumor cells at the time of surgery, which could have been removed if the fluorescence microscope were available.

When PDT is performed, the type and intensity of the light source can affect the degree of cytotoxicity. The peak absorption of AO is 497 nm (blue-green light) and a filtered monochromatic laser source that emits blue-green light would be the most efficient light source. However, we used an unfiltered xenon lamp, which emits visible light with a range of 400 to 700 nm, is less expensive than laser systems, and is more convenient when a large area (>5 cm²) needs to be illuminated (36). The xenon lamp can also excite AO and induce cytotoxicity against mouse osteosarcoma cells (36). In that study, in vitro mouse osteosarcoma cells pretreated with AO showed significant cytotoxicity when illuminated with 100 000 lux, but no cytotoxicity with 10 000 lux. In our study, illuminance was measured as power density, which was 20.7 mW/cm², well below the 125 mW/cm² required for hyperthermia-induced cytotoxicity (15). If the light used in our study were monochromatic and had a wavelength of 555 nm (average wavelength of the light used in this study), 20.7 mW/cm² corresponds to 141 381 lux (37). Therefore, the illuminance used in this study was likely sufficient to induce significant cytotoxicity.

This study had several limitations that are inherent to retrospective studies, such as variability in the stage of the tumors, treatment methods, and follow-up periods, and lack of follow-up imaging in some cases. In addition, the sample size was small. It is difficult to evaluate the relative contribution of each treatment modality (surgery, PDT, electron radiation, and radiodynamic therapy) to the observed disease-free intervals and side effects. The intra-operative electron beam dose was chosen so it would not exceed 30 Gy, based on one report that dogs receiving over 30 Gy during such therapy had a higher incidence of radiation-induced sarcomas (38). Furthermore, the planning CT was performed before surgery, but X-ray irradiation (radiodynamic therapy) was performed after surgery. Therefore, the dose of X-ray calculated might have been inaccurate, due to the lack of gross disease (which was present at the time of CT) at the time of irradiation. Longer follow-up time is needed to assess late side effects. The dose of the electron beam was high, which theoretically increases the risk of serious late side effects, such as brain necrosis. In addition, CTV and PTV were not defined. This is not a conventional way of performing radiation therapy and could have led to a geographic miss (i.e., tumor cells being outside of the area irradiated by X-ray), which could have happened in some cases in this study. The novel treatment method described herein warrants further evaluation, with a prospective study with a higher number of cases and standardized treatment and follow-up schedules.

References


Sialolithiasis in horses: A retrospective study of 25 cases (2002–2013)
Nicholas Carlson, Tim Eastman, Laramie Winfield

Abstract — This study evaluated outcomes of surgical treatment of equine sialolithiasis, highlighting cases involving the proximal parotid salivary duct. Sialoliths in the proximal parotid duct were difficult to identify radiographically and more frequently associated with draining tracts and sialadenitis compared with sialoliths in the distal parotid duct. Ultrasonography confirmed the diagnosis of sialolithiasis in all cases in which there was no radiographic evidence of a sialolith. All cases of proximal parotid duct sialolithiasis required transcutaneous removal. A longer duration of illness was observed in cases of proximal parotid duct sialolithiasis compared with cases involving the distal parotid duct, and in cases requiring transcutaneous removal compared with cases requiring transoral removal. Recurrence of sialolithiasis was documented in 24% of cases, all of which were located in the distal parotid duct. The average time to recurrence was 2.8 years.

Résumé — Sialolithiase chez les chevaux : une étude rétrospective de 25 cas (2002–2013). Cette étude a évalué les résultats du traitement chirurgical de la sialolithiase équine et a mis en lumière des cas touchant le canal salivaire parotidien proximal. Les sialolithes du canal de Sténon étaient difficiles à identifier par radiographie et sont plus fréquemment associés à des faisceaux de drainage et à la sialadénite par opposition à des sialolithes dans le canal de Sténon distal. L’échographie a confirmé le diagnostic de sialolithiase dans tous les cas où il y avait des preuves radiographiques d’un sialolithe. Tous les cas de sialolithiase du canal salivaire parotidien proximal ont exigé une ablation transcutanée. Une plus longue durée de la maladie a été observée dans les cas de sialolithiase du canal salivaire parotidien proximal par opposition aux cas touchant le canal de Sténon distant et, dans les cas exigeant l’ablation transcutanée par opposition aux cas exigeant l’enlèvement transoral. La récurrence de la sialolithiase a été documentée dans 24 % des cas et ils étaient tous situés dans le canal salivaire distant. Le délai moyen avant la récurrence était de 2,8 ans.

(Traduit par Isabelle Vallières)

Introduction
Sialolithiasis is an infrequently encountered condition in equids (1). Sialoliths are more frequently observed within the distal parotid salivary duct with cases involving the proximal parotid duct or other salivary ducts rarely documented in the literature (2–4).

Typically, a sialolith in the parotid duct presents as a firm, freely movable mass near the rostral aspect of the facial crest (2). Disease may remain subclinical, but acute obstruction of the salivary gland may lead to painful parotid distention and localized facial swelling with subsequent sialadenitis (2,4,5). Diagnosis of sialolithiasis can be confirmed with radiographs and ultrasound of the swelling and surrounding salivary duct (4,6–8).

Both transcutaneous and transoral surgical techniques have been described for removal of sialoliths in the horse (2). Transcutaneous removal of sialoliths has been associated with increased incidence of post-operative infection at the surgical site and fistula formation compared with transoral removal, and also presents a risk for iatrogenic damage to the maxillary branch of the facial nerve (9). While transoral sialolith removal has been advocated in the literature, information about long-term outcome for only a small number of cases is available (4,6,7,9). The recurrence of sialoliths following surgical removal has not been reported in the horse. The purpose of this paper was to review cases of equine sialolithiasis describing diagnostic findings, surgical techniques, and outcomes for affected animals.

Materials and methods
Medical records of equine patients presenting to Steinbeck Country Equine Clinic were reviewed for cases of sialolithiasis from 2002 to 2013. In all cases, the diagnosis was confirmed by surgically removing the sialolith. Data recorded included...
signalment, clinical signs, and when available, oral examination and diagnostic imaging findings. Concurrent sialadenitis was diagnosed based on the presence of warm, swollen, and painful salivary glands with definitive diagnosis made with cytology and culture of the saliva. The type of surgical procedure performed in each case was recorded along with post-operative treatments, and complications. Information in the medical record and follow-up telephone conversation with owners were used to obtain information about long-term outcome and recurrence.

Sialoliths were classified by affected salivary duct and subcategorized according to location within the salivary duct for parotid duct cases. The distal parotid duct was previously defined as the portion of the duct that passes along the rostral border of the masseter muscle and exits into the oral cavity at the level of the second or third maxillary premolar (1). This study defines the proximal duct as the remaining portion of the salivary duct as it courses with the horizontal ramus of the mandible and ascends along the vertical ramus of the mandible to the parotid salivary gland.

**Surgical removal of sialolith through a transoral approach**

Sialoliths located in the distal parotid duct were surgically removed via standing sedation with detomidine hydrochloride (Orion Corp., Espo, Finland), 0.01 mg/kg, body weight (BW), IV, or injectable anesthesia based on the horse’s demeanor and surgeon’s preference.

An oral speculum (McPherson) was fitted and 2% lidocaine hydrochloride (Henry Schein Animal Health, Dublin, Ohio, USA) was injected into the buccal mucosa surrounding the sialolith. Malleable retractors were used to retract the buccal mucosa away from the maxillary cheek teeth. A #12 scalpel blade was used to create a linear incision through the buccal mucosa over the length of the sialolith using it as a guard to keep the blade

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**Figure 1.** Sialoliths in the parotid and mandibular salivary ducts. A – A single sialolith located in the distal parotid duct adjacent to the first maxillary molar prior to the creation of an incision over the buccal mucosa. B – Digital pressure over the sialolith extra-orally aids in its removal into the oral cavity. C – An example of a sialolith in the mandibular salivary duct at the level of the sublingual caruncle prior to its removal.
from penetrating into deeper tissues. Sharp dissection continued through the fibrotic capsule surrounding the sialolith within the duct. Extra oral pressure over the sialolith aided in its removal into the oral cavity (Figure 1). The incision was lavaged with 0.12% chlorhexidine gluconate (Vet One Boise, Idaho, USA), and left open to heal by second intention. Mandibular duct sialoliths were removed in a similar fashion as described.

**Surgical removal of sialoliths through a transcutaneous approach**

All horses were treated under general anesthesia to reduce the chance of iatrogenic damage to the facial artery and vein, which course beside the proximal aspect of the parotid duct and the linguofacial vein, which lies adjacent to the parotid duct as the duct exits the parotid salivary gland. Horses were sedated with xylazine hydrochloride (Akorn, Decatur, Illinois, USA), 1.1 mg/kg BW, IV, followed by induction with diazepam (Hospira, Lake Forest, Illinois, USA), 0.05 mg/kg BW, IV, and ketamine (Bioniche Pharma, Lake Forest, Illinois, USA), 2.2 mg/kg BW, IV. Anesthesia was maintained with a constant rate infusion of triple drip composed of a combination of 500 mg xylazine hydrochloride and 1000 mg ketamine hydrochloride mixed in a 1 L bag of 5% guaifenesin (Wedgwood Pharmacy, Swedesboro, New Jersey, USA), and administered at a rate up to 2 mL/kg BW per hour.

If a draining tract was present it was surgically debrided and lavaged. Concurrent cannulation of the parotid papilla facilitated retrograde lavage of the parotid duct with saline to aid in dislodgement of the sialolith while confirming communication of the salivary duct to the draining tract. Post-operative catheterization of the duct was not maintained in these cases. Due to extensive contamination of the surgical sites and difficulty in reconstruction of the parotid duct from the chronic infection, draining tracts were left open to heal by second intention.

In cases where no draining tract was present prior to surgery, an incision was made over the sialolith with a #15 scalpel blade through the skin and subcutaneous tissues extending into the parotid salivary duct. Following retrieval of the sialolith the tissues were lavaged with saline, and primary closure of the parotid duct was facilitated by a preplaced 5-French polypropylene urinary catheter through the parotid papilla extending beyond the surgical incision to the more aborad portion of the duct. The parotid duct was re-apposed with 4-0 polydioxanone (Ethicon, Somerville, New Jersey, USA), in a simple interrupted pattern. The subcutaneous tissue was closed with a 2-0 polydioxanone in a simple continuous pattern, and the skin was closed with skin staples. The catheter was maintained in the parotid salivary duct for 7 d after surgery to maintain duct patency and to reduce salivary flow over the surgical site. A stab incision through the skin rostral to the parotid papilla was made facilitating passage of the catheter out of the oral cavity where it was secured to the skin.

![Figure 2. Dorso-ventral radiographic views of 2 sialoliths. Sialoliths are typically identified radiographically as round to ovoid radiodense bodies adjacent to the maxillary molars. A – They may display concentric layers of mineralization surrounding a radiolucent core often associated with organic debris such as a plant awn. B – An example of multiple sialoliths (arrows) of various sizes located within the parotid salivary duct. The superimposition of the sialoliths upon each other and skull structures can make identification of all sialoliths difficult.](image)

![Figure 3. Ultrasonographic evidence of sialolithiasis within the parotid salivary duct. A – A cross-sectional image through the salivary duct. Ultrasound probe orientation is indicated by the green dot which is rostral in this image. A hyperechoic mass consistent with a sialolith is identified with the wide arrow without tail. The facial artery is identified with the narrow arrow with tail to the left of the sialolith. B – A long axis view through the parotid salivary duct. Ultrasound probe orientation is indicated by the green dot which is dorsal in this image. The hyperechoic sialolith (arrow) is blocking salivary flow causing parotid duct distention (outlined by arrowheads).](image)
with simple interrupted sutures of 0 polypropylene (Ethicon), to prevent premature dislodgement by the horse.

**Statistical analysis**

Continuous data were expressed as a mean with a range, and a median was provided for the variable duration of clinical signs due to outliers in this data set. Categorical data were presented with the number of cases identified with a corresponding percentage.

**Results**

A total of 25 cases of sialolithiasis were identified. Breeds included American Quarter Horses (*n* = 9), Thoroughbreds (*n* = 8), Arabians (*n* = 3), Warmbloods (*n* = 3), an Appaloosa (*n* = 1), and a Tennessee Walking Horse (*n* = 1). There were 12 mares and 13 geldings. The horses ranged from 4 to 29 years of age (mean age = 16.8 y).

Duration of clinical signs prior to presentation as reported by the owner ranged from 2 d to 7 y (mean 19 mo, median 8 mo). The parotid duct was involved in 23/25 (92%) cases, with mandibular duct involvement observed in only 2 cases. Most cases involving the parotid duct were located in the distal 18/23 (78%) versus the proximal 5/23 (22%) duct. Both cases involving the mandibular duct were observed in the oral aspect of the duct near the sublingual caruncle (Figure 1).

Findings at presentation included facial swelling 20/25 (80%), quidding 7/25 (28%), cutaneous draining tract 6/25 (24%), fever 4/25 (16%), halitosis 3/25 (12%), inappetence 3/25 (12%), and facial nerve paralysis on the ipsilateral side (12/19 (63%) were administered sulfamethoxazole trimethoprim (Amneal Pharmaceuticals, Hauppauge, New York, USA), 30 mg/kg BW, PO, q12h for an average of 8 d (range: 5 to 14 d). In 11 cases with follow-up data, the average healing time of the oral incision was 9 d. One horse developed a pronounced focal cellulitis 24 h after intra-oral sialolith removal with substantial packing of feed into the surgical wound. In addition to antibiotics, this horse received daily oral lavage and application of a warm compress to the region for 4 d. The cellulitis resolved within 72 h. Two horses had small cutaneous draining tracts on presentation that were not surgically debrided due to their small size. Both continued to drain small amounts of saliva at discharge from the hospital, but the drainage had discontinued by 10 d. At initial presentation, 1 of these 2 cases also had concurrent facial nerve paralysis on the ipsilateral side of the sialolith that did not improve after surgery.

Transcutaneous removal of sialoliths with primary closure was performed on 2 horses. Neither horse had cutaneous draining tracts at the time of presentation. One horse had a large sialolith in the distal parotid duct and was a candidate for transoral removal, but it was removed trancutaneously at the owner’s request due to concerns with using a speculum with their horse. The second horse had a sialolith removed from the proximal parotid duct that was inaccessible via the oral cavity. In both cases an intra-parotid catheter was kept in place for 7 d after surgery. Both horses were administered phenylbutazone (Sparhawk Laboratories), 2.2 mg/kg BW, PO, q12h for 5 d, and sulfamethoxazole trimethoprim (Amneal Pharmaceuticals), 30 mg/kg BW, PO, q12h for 10 d. None of these horses had developed any complications by the time of suture removal 14 d after surgery.

Cutaneous draining tracts involving the proximal parotid duct were observed in 4 horses. In these cases the draining tracts were explored surgically, sialoliths were identified and removed, but the surgical sites were left open to heal by second intention without maintaining a post-operative intra-parotid duct catheter. All 4 horses had persistent salivary drainage from a cutaneous fistula after surgery. One horse experienced recurrent intermittent drainage from the site for 3 mo after surgery, and was euthanized for an unrelated small intestinal colic. This horse was administered phenylbutazone (Sparhawk Laboratories), 2.2 mg/kg BW, PO, q12h for 10 d and sulfamethoxazole trimethoprim (Amneal Pharmaceuticals), 30 mg/kg BW, PO, q12h for 42 d, but these were discontinued by the owner due to financial constraints. In 2 of these cases 10% formalin was injected into the parotid gland via parotid duct cannulation causing gland involution with loss of saliva production before healing of the tract was observed. The fourth horse had slight drainage of saliva after surgery, which resolved after post-operative administration of antimicrobials and an anti-inflammatory drug. Excluding the horse that was euthanized, these 3 horses were treated with phenylbutazone (Sparhawk Laboratories), 2.2 mg/kg BW, PO, q12h for an average of 11 d (range: 10 to 14 d), sulfamethoxazole trimethoprim (Amneal Pharmaceuticals), 30 mg/kg BW, PO, q12h for an average of 56 d (range: 42 to 70 d). Average time until healing of these 3 horses was 47 d (range: 28 to 84 d).

Complications and failure of treatment included persistence of cutaneous draining tracts (short-term: 2; long term: 4), significant
post-operative cellulitis in 1 horse, and prolonged facial nerve paralysis in 1 horse. Horses encountered post-operative complications more frequently if they had a sialolith in the proximal parotid duct 4/5 (80%) versus the distal parotid duct 2/18 (11%), had a cutaneous draining tract at presentation 6/6 (100%) versus not having a draining tract at presentation 1/19 (5%), or had transcutaneous surgery 4/6 (67%) compared with intra-oral surgery 3/19 (16%).

Recurrence was observed in 6 horses with sialoliths located in the distal parotid duct. All recurrence was observed in the same location and duct as the initial sialolith. Single recurrence occurred in 4 horses and multiple recurrences occurred in 2 horses. One horse had multiple sialoliths identified on radiographs at initial presentation, and again developed multiple sialoliths 5 y later. The other horse with multiple recurrences initially presented with bilateral sialoliths in the distal ducts, but on 3 subsequent recurrences developed a singular large sialolith in the left distal parotid duct at approximately 1 y intervals. Average time to recurrence was 2.8 y following the initial surgery (range: 1 to 5 y).

Discussion

Sialolithiasis may be a chronic problem in horses, with the mean duration of clinical signs prior to diagnosis being 18 mo in this study. The long duration of clinical signs prior to surgical removal may be multifactorial. Some owners did not seek veterinary attention after being made aware of the sialolith’s presence until their horse was significantly impacted by the sialolith. In some cases with cutaneous draining tracts due to the contaminated surgical site and difficulty in apposition of the proximal and distal portions of the duct, other studies have advocated its use to aid in reconstruction during surgical closure and reduce complications (3,15). Maintenance of this stent after surgery may reduce the likelihood that stricture or a fistula will form by decreasing salivary flow over the surgical site (2,3). These findings are supported by our study as well, with no complications noted in either of the horses in which a stent was used after transcutaneous removal of a sialolith. Despite successful outcomes in 2 cases in this study, transcutaneous removal of sialoliths is not preferred by the authors due to concerns of fistula development. However, this may be required in some cases if the sialolith is inaccessible through the oral cavity.

In the present study primary closure was not attempted in cases with cutaneous draining tracts due to the contaminated surgical site and difficulty in apposition of the proximal and distal portions of the duct. All horses experienced delayed healing due to chronic fistulation at the surgical site. Resolution of the draining tracts of 2 horses was achieved following chemical
ablation of the salivary gland with 10% formalin. Formalin was chosen as it has been suggested to cause the least amount of necrosis and supplicative inflammation compared to iodine, chlorhexidine, and silver nitrate (2). Resolution of the fistula of another horse was accomplished without surgery, but required nearly 3 mo of daily antibiotics and cleaning of the site by the owner. Spontaneous closure of salivary fistulas has been reported in the literature, but in our experience healing is unpredictable and requires a long convalescence period (1,16). To hasten resolution of a fistula, the authors recommend making an effort to reconstruct the salivary duct using an intra-duct catheter to divert salivary flow without primary closure, or ligating the duct proximal to the fistula (1,15). The latter may be less desirable as it prevents drainage of purulent salivary discharge from a concurrent sialadenitis.

Transoral approach to sialolith removal has been advocated to prevent development of external salivary fistula (2,9). Minimal complications were observed in the current study with only 1 horse developing post-operative local cellulitis. It is possible that the development of a localized cellulitis is more common than reported in this study, as most may remain subclinical. In addition, 2 horses with transoral removal of distal parotid duct sialoliths had small cutaneous draining tracts and concurrent regional cellulitis at presentation. Following surgery both horses experienced continued drainage in the immediate post-operative period, but unlike the cases of proximal duct sialolithiasis, these horses healed quickly without additional intervention. The faster resolution of these draining tracts was attributed to their initial smaller size and diversion of salivary flow into the oral cavity through the transoral incision. In addition, 1 horse had facial nerve paralysis on the ipsilateral side of the sialolith, cellulitis, and draining tract at initial presentation. Despite resolution of the draining tract and cellulitis the facial nerve paralysis persisted. A full workup of the facial nerve paralysis was not pursued by the owner, but the paralysis was speculated to be secondary to pressure necrosis from the sialolith and infection in the surrounding tissue from the ruptured parotid duct.

Reurrence of sialolithiasis has not been reported in horses. Recurrence rates in humans utilizing transoral removal of sialoliths range from 10% to 18% compared to 24% (6/25) in our study (17,18). In humans, recurrence is most commonly attributed to lack of identification and removal of all sialoliths at the time of surgery (18). Ultrasonography plays an important role in reducing recurrence of human sialolithiasis by identifying radiolucent sialoliths or sialolith fragments that could act as a future nidus (18). Ultrasonography was not performed in any of the horses that experienced recurrence, and failure to identify and remove all sialoths at the time of surgery may have contributed to recurrence. Additional causes of recurrence documented in humans are duct stricture at the surgical site and salivary composition (19). It is interesting that recurrence developed on the same side as was initially affected in all cases, making scar tissue and incomplete initial removal of the sialolith possible factors contributing to recurrence. Salivary composition was not evaluated in these cases, and warrants further investigation.

Based on our findings both radiography and ultrasonography are important in the diagnosis of sialolithiasis, and ultrasonography may help identify sialoliths not visible on radiographs. A longer morbidity should be expected in cases involving the proximal duct, especially when a cutaneous draining tract is present prior to surgery. Owners should be aware that recurrence of sialolithiasis is possible, occurring in 24% of cases in this study.

References

Abstract — A mixed-mode survey was used to describe the demographics of the veterinary profession in western Canada and to assess the demand for veterinary practitioners. Data were received from 655 practices (response rate = 52%), providing demographic data on 1636 individual practitioners. Most (60%) respondents self-classified their practices as exclusively small animal, while 25% and 4% were mixed animal or exclusively food animal practices, respectively. Across all practices, 77% of practitioners’ time was devoted to small animals and the average mixed animal practice devoted 60% of practitioners’ time to small animals. After accounting for practices that did not respond, there were ~300 full-time equivalent (FTE) vacant positions for veterinary associates; however, only 12% of practices were in urgent need of hiring an associate veterinarian. This report informs both prospective employees and employers on the state of the marketplace for veterinary associates, and provides an overview of the demographics of the veterinary profession in western Canada.

Résumé — Enquête auprès des pratiques vétérinaires de l'Ouest canadien : un profil démographique. Une enquête de type mixte a été utilisée pour décrire les données démographiques de la profession vétérinaire dans l’Ouest canadien et évaluer la demande de praticiens vétérinaires. Des données ont été reçues de 655 pratiques (taux de réponse = 52 %) et ont fourni des données démographiques sur 1636 praticiens individuels. La majorité (60 %) des répondants ont classé leur pratique comme traitant exclusivement des petits animaux, tandis que 25 % et 4 % étaient des pratiques mixtes ou exclusivement pour animaux destinés à l'alimentation. Dans toutes les pratiques, 77 % du temps des praticiens était consacré aux petits animaux et la pratique mixte moyenne consacrait 60 % du temps des praticiens aux petits animaux. Après avoir tenu compte des pratiques qui n’ont pas répondu, il y avait ~300 postes équivalent temps plein (ETP) vacants pour les vétérinaires salariés. Cependant, seulement 12 % des pratiques éprouvaient un besoin urgent d’embaucher un vétérinaire salarié. Ce rapport informe les employés et les employeurs éventuels sur l’état du marché pour les vétérinaires salariés et présente un aperçu des données démographiques de la profession vétérinaire dans l’Ouest canadien.

Can Vet J 2015;56:1245–1251

Introduction

A survey of the western Canadian veterinary profession conducted in 2006 found that 64% of all veterinary practices were exclusively companion animal oriented, wherein they devoted 100% of time to small animals and equine practice (1). Conversely, only 4% were considered to be exclusively food animal practices. When examined at the level of the individual practitioner, 73% of all practitioners’ time was devoted to small animals, 11% to beef cattle, and 9% to horses. The survey also estimated that western Canada had ~350 vacant full-time equivalent (FTE) positions, with companion animal practitioners being in the greatest demand. Furthermore, 60% of practices were 1- and 2-person practices and the larger multi-person practices (≥ 4 veterinarians) were twice as likely as the smaller practices to be looking to hire.

While the 2006 study provided insight into the demand for veterinary associates, the finding of 350 FTE vacant positions seemed incongruent with the relatively low number of employment positions advertised on-line or in print. Therefore, a second survey was conducted in 2008, but this time practices were asked to qualify how motivated or determined they were with regards to their hiring intentions (2). As per the 2006 study, there was a large number of vacancies (314 FTEs); however, only 8% of practices were “in urgent need of another veterinarian and would hire anyone who is qualified for the job.” This second survey confirmed that while many practices may be passively...
looking to hire at any given time, the actual number in urgent need of an associate was far less.

In the previous 2 surveys, most survey respondents had self-classified their practices as being exclusively companion animal oriented. This was consistent with a retrospective study that examined the demographics of the western Canadian veterinary profession over a 16-year period, 1991 to 2007 (3). In this study, 60% of practices listed in the veterinary directories were companion animal (small animal or equine) practices, whereas 32% and 8% of practices were classified as mixed or food animal practices, respectively.

The purpose of this study was to provide a more contemporary overview of the demographics of the veterinary profession in western Canada, and to assess the demand for veterinary associates.

Materials and methods
Survey questionnaire
A short survey, consisting of 8 questions, was sent to all veterinary practices in western Canada, which includes the provinces of British Columbia (BC), Alberta (AB), Saskatchewan (SK), and Manitoba (MB). The first 4 questions were dedicated to gathering practice and practitioner level demographic data. In addition to providing the practice's name and location (postal code), each respondent was asked to self-classify their practice into 1 of 6 types: exclusively (100%) small animal (SA); exclusively food animal (FA); exclusively equine (EQ); exclusively companion animal (CA), which included equine and small animal; exclusively large animal (LA), which included food animal and equine; and all other forms of private practice (“Other”). Respondents also provided the following data for each veterinarian within their practice: college and year of graduation; gender; average number of hours worked/wk; and the amount (%) of practice time each veterinarian devoted to small animals, beef, dairy, equine, swine, poultry, “other,” and managing the practice.

Questions 5 to 7 were used to assess the quantitative and qualitative demand for veterinary associates. Veterinary practices that were looking to hire were asked to provide the salary being offered and how many hours/wk the new associate was expected to work. In addition, they were asked to select which statement best described their level of urgency regarding hiring intentions:
1) **Not actively looking, but would hire if an ideal veterinary associate approached you**;
2) **Not urgent, but have a potential candidate in mind**;
3) **Advertising by “word of mouth” and/or proactively contacting specific veterinarians**;
4) **Using multiple avenues of advertising, some degree of urgency, but new hire must fulfill specific hiring criteria**;
5) **Need someone immediately, willing to compromise on hiring, would consider hiring a locum as a bridge to a full-time hire**.

The last of the 8 survey questions asked respondents to indicate which strategies or methods they were currently using to attract another veterinary associate.

Survey administration
The sampling frame was generated from the veterinary directories (printed and on-line) of the 4 western provincial veterinary medical associations. In May, 2014, there were 1294 veterinary practices listed in the 4 directories and each was mailed a survey package comprised of a covering letter explaining the purpose of the survey; the survey questionnaire; and a self-addressed, postage-paid, return envelope. Respondents were also provided with the option of sending the completed surveys by facsimile (fax). Practices with e-mail addresses (n = 749) were sent a reminder 2 wk after the initial mailing; 106 of which were returned as undeliverable. Within 1 mo of the initial mailing, an on-line version of the survey was created (FluidSurveys™) and e-mail notifications were sent to all the nonresponders advising them of the on-line option for completing the survey. A second survey package was mailed in July, 2014 to all nonresponders. Two additional e-mail reminders were sent over the next 2 to 6 wk and returns were accepted until October 1, 2014.

Data management and analysis
Data from the completed surveys were entered on a commercial spreadsheet program (Microsoft Excel 2013) and imported into a statistical software package (SPSS Version 22; SPSS, Armonk,
Results

Of the 1294 practices mailed a survey package, 10 were omitted because they either amalgamated with, or were a satellite of, another practice. Canada Post also returned 28 mailings as undeliverable (moved or unknown address). Therefore, the final sampling frame was comprised of 1256 veterinary practices, 52% \((n = 655)\) of which returned a completed survey. Not every practice completed every question, hence the denominator (number of survey responses) changed slightly with each question. Survey response rates varied by province \((P < 0.001)\): BC, 51% (274/535); AB, 48% (227/474); SK, 72% \((n = 101/140)\); and MB, 50% (53/107).

Practice data

Table 1 shows how the respondents self-classified their practices; 3 practices self-classified as "Other" and because of this small number they were omitted from the table and analyses. Overall, 60% \((n = 391)\) of respondents self-classified their practices as exclusively SA; 5% exclusively EQ, \((n = 32)\); 4% CA (small animal and equine), \((n = 23)\); 25% MA, \((n = 169)\); 4% FA, \((n = 28)\); and 2% LA (food animal and equine), \((n = 12)\). When combined, the SA, EQ, and CA practices represented 69% of practices. This compares favorably to the classification of practices by the amount of time each practitioner devoted to each species. In this scheme 68% \((n = 438)\) of practices were CAP practices (small animal, equine, and other), 26% \((n = 166)\) MAP, and 6% \((n = 41)\) FAP.

Table 2 provides a breakdown of the MA practices by the amount of time they devoted to the 3 main types of practice (small animals, food animals, and equine). In general, mixed practice is primarily companion animal practice with only 28% of time being devoted to food animals.

Practice size ranged from 1 to 17 veterinarians with the mean (median) being 2.4 (2.0) veterinarians/practice. Figure 1 shows the percentage of practices by size and type (CAP, FAP, and New York, USA). Data collected online (FluidSurveys\textsuperscript{TM}) were also imported into Excel and collated with the other results. Descriptive statistics were performed on each outcome variable and analytical statistics were used to assess the data at a level of significance of \(P < 0.05\) (two-tailed). Student's \(t\)-test and analysis of variance (ANOVA) were used to assess the normally distributed data. The Chi-square test statistics was used to analyze the frequency, such as the survey response rates by province and the number of practices looking to hire by practice size.

The mid-point was used for all salary or work week data provided as a range. Vacancies were analyzed as either part- or full-time positions with full-time employment being defined as working \(\geq 35\) h/wk. The number of part- and full-time vacant positions were summed and reported as the total number of full-time equivalents (FTEs).

The Kruskal-Wallis test statistic was used to determine if the level of urgency related to hiring varied by practice type and size of practice (number of veterinarians). If a practice was looking to hire multiple associates, then only the primary position (first vacancy listed in the survey response) was included in the analyses. Only the primary or first vacant position listed was analyzed because it was assumed that this position would have the highest level of urgency.

Two schemes were used to classify the veterinary practices. The first scheme was based on the results of the survey in which respondents were asked to self-classify their practices according to 1 of 6 options (SA, FA, EQ, CA, LA, and “Other”). The second classification scheme used the individual practitioner data to calculate the total number of hours each practice devoted to each type of practice (small animals, beef, dairy, equine, swine, poultry, and other) on a weekly basis. These hours were divided by the total number of all hours worked by the practice's veterinarians, which provided the percent of time each practice devoted to each species.

The practices were then categorized into 3 practice types: companion animal (CAP), mixed animal (MAP), and food animal (FAP) practice. The CAP practices devoted 100% of the practitioners' time to small animals (SA), horses (EQ), and Other. The FAP practices devoted > 50% of the veterinarians' time to food animals, while the MAP practices devoted 1% to 50% of the practitioners’ time to food animals (beef, dairy, swine, and poultry). The same classification scheme was used to classify the individual veterinary practitioners.
Table 3. Percent of respondents by employment status (full-time, part-time), gender, and practice type. Full-time veterinarians worked ≥ 35 hours/week

<table>
<thead>
<tr>
<th>Gender (n = 1559)</th>
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<th>Part-time</th>
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<tbody>
<tr>
<td>Females (n = 931)</td>
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<tr>
<td>Males (n = 628)</td>
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<td>Weighted mean</td>
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<tr>
<td>CAP (n = 1163)</td>
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<td>41</td>
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<tr>
<td>MAP (n = 237)</td>
<td>87</td>
<td>13</td>
</tr>
<tr>
<td>FAP (n = 169)</td>
<td>81</td>
<td>19</td>
</tr>
</tbody>
</table>

CAP — Companion animal practice, practice veterinarian(s) devoted 100% of time to small animals, equine, and “other;” MAP — Mixed animal practice, practice veterinarian(s) devoted 1% to 50% of time to food animals; FAP — Food animal practice, practice veterinarian(s) devoted > 50% of time to beef, dairy, swine, and poultry.

Table 4. Percent of respondents by practice type and college of graduation (n = 1586)

<table>
<thead>
<tr>
<th>Practice type</th>
<th>CAP</th>
<th>FAP</th>
<th>MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>WCV (n = 1053)</td>
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<td>FMV (n = 13)</td>
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<td>0</td>
</tr>
<tr>
<td>Weighted mean</td>
<td>73</td>
<td>11</td>
<td>16</td>
</tr>
</tbody>
</table>

AVC — Atlantic Veterinary College, Charlottetown, Prince Edward Island; FMV — Faculté de Médecine Vétérinaire, Saint-Hyacinthe, Quebec; OVC — Ontario Veterinary College, Guelph, Ontario; WCVM — Western College of Veterinary Medicine, Saskatoon, Saskatchewan; UCVM — University of Calgary — Faculty of Veterinary Medicine, Calgary, Alberta; CAP — Companion animal practice, practice veterinarian(s) devoted 100% of time to small animals, equine, and “other;” MAP — Mixed animal practice, practice veterinarian(s) devoted 1% to 50% of time to food animals; FAP — Food animal practice, practice veterinarian(s) devoted > 50% of time to beef, dairy, swine, and poultry.

MAP). The most common practice was the 1-person practice and 65% of all practices were either a 1- or 2-person practice.

Practitioner data

Respondents provided data on 1636 individual practitioners, 59% of whom were female. The population pyramid (Figure 2) classifies the respondents by gender and age; age was estimated by adding 26 y to the number of years since graduation. The pyramid shows a large cohort of young female veterinarians ≤ 39 y of age and a large grouping of older male veterinarians 40 to 59 y of age.

Although the profession is more heavily weighted towards females, a greater percentage of males (76%) than females (58%) were working on a full-time basis (Table 3). Furthermore, a greater percentage of CA practitioners were working on a part-time basis compared to their MA or FA counterparts (P < 0.001). This latter finding, however, may be confounded by gender; 66% of CA practitioners were females as compared to 53% of MA and 23% of FA practitioners (P < 0.001).

The majority of practitioners had graduated from the Western College of Veterinary Medicine (64%; n = 1056), followed by the Ontario Veterinary College 10% (n = 157); Atlantic Veterinary College 3% (n = 54); University of Calgary Faculty of Veterinary Medicine 2% (n = 30), Faculté de Médecine Vétérinaire 1% (n = 13), and 20% (n = 326) were foreign graduates.

Table 4 is a cross-tabulation of the respondents by practice type and college of graduation. Most (89%) foreign graduates were employed in CAP practice. Caution is needed when interpreting the University of Calgary, Faculty of Veterinary Medicine (UCVM) and the Faculté de Médecine Vétérinaire graduate data because the results are based on a relatively small number of respondents. The 9 UCVM graduates in MAP practice devoted 5% to 35% of their time to food animals.

Ignoring hours spent on practice management, 644 veterinary practices in western Canada, representing 1573 individual practitioners, spent ~55 400 h/wk ministering to animals. Figure 3 shows how the aggregate time of all practising veterinarians in western Canada is apportioned to each type of practice (species) in a typical week. The majority of time (77%) is devoted to small animals, whereas food animals account for 14% of practitioners’ time. Nearly half (46%; n = 745) of practitioners were exclusively involved with small animals, whereas only 3% of were either exclusively equine (n = 43) or exclusively food animal (n = 45) practitioners.

Recruitment data

Overall, 25% (n = 163/643) of practices were looking to hire another veterinary associate and there was no difference (P = 0.25) in hiring intentions by practice type: 25% CA (n = 108/436), 29% MA (n = 48/166), and 17% FA (n = 7/41). The vacancies were comprised of 183 part and full-time positions with the number of vacancies/practice ranging from 0.5 to 3.0 FTEs. Fourteen practices were looking to hire 2 associates and 2 practices were looking to hire 3 associates. The sum of the vacancies represented 157 FTEs, which after factoring in a 52% response rate, extrapolates to ~300 vacant FTEs in western Canada.

The following is the proportion of respondents who identified 1 of the 5 statements relating to hiring intentions: 23% (n = 37) “Not actively looking, but would hire if an ideal veterinary associate approached you;” 17% (n = 28), “Not urgent, but have a potential candidate in mind;” 22% (n = 36), “Advertising
by “word of mouth” and/or proactively contacting specific veterinarians.” 26% (n = 41), “Using multiple avenues of advertising, some degree of urgency, but new hire must fulfill specific hiring criteria;” and 12% (n = 19), “Need someone immediately, willing to compromise on hiring, would consider hiring a locum as a bridge to a full-time hire.” There was no difference in the hiring intentions by practice size, regardless of whether small practices were defined as having ≤ 2 practitioners (P = 0.22), ≤ 3 practitioners (P = 0.18), or ≤ 4 practitioners/practice (P = 0.50). There was also no difference in the level of urgency to hire across the 3 main practice types (P = 0.90).

Table 5 is a cross-tabulation of the salary data by practice type and province. These data were restricted to full-time vacancies (≥ 35 h/wk) and to the primary vacant position. The overall mean salary offered for a full-time position was $76 700 (median = $75 000, 95% CI = $74 800 to $78 800). There was no difference in the average base salaries offered by practice type (P = 0.79) or province of employment (P = 0.41).

Table 6 is a summary of the hiring strategies that practices use to attract new employees. “Word of mouth” was the most commonly used strategy (67%), followed by advertising with a provincial veterinary association (47%), and screening unsolicited applicants (36%).

Discussion

Approximately 52% of all veterinary practices in western Canada responded to the survey, which is comparable to the 64% and 47% response rates for the 2006 (1) and 2008 (2) surveys, respectively. The fact that 1 in 2 practices would take the time to complete the survey is indicative of the level of interest in veterinary demographics and hiring intentions. As for all surveys, some degree of caution is warranted when interpreting the results because answers provided by the respondents may not necessarily reflect how nonresponders would have answered; this is commonly termed a nonresponse error or bias (3). This bias may have arisen when extrapolating the survey’s vacancy data to the broader profession. Twenty-five percent of practices were looking to hire; however, those looking to hire are probably more likely to participate in a survey relating to hiring veterinary associates. Therefore, the extrapolation that western Canada may have as many as 300 FTE vacancies is probably an overestimate of the true number of vacancies.

The survey questionnaire and the methodology used to conduct the survey were very similar to that of the 2006 (1) and 2008 (2) surveys, which allows for some comparison of data across time. This is particularly true of the question related to whether practices were looking to hire, and if so, how many FTE vacancies were they looking to fill? Based on the data generated from the 3 surveys, it would appear that the demand for veterinary associates across western Canada may be weakening.

There were 347 FTE vacancies in 2006 compared to 314 in 2008 and ~300 in the current study. Furthermore, the number of veterinary practices in western Canada has increased by 14% since 2006. Therefore, while the overall marketplace for veterinarians has been expanding, the absolute number of FTE vacancies has been decreasing.

Although 300 FTE vacant positions sounds like a large number, only 12% of practices were in urgent need of hiring. It is, however, more difficult to gauge this level of urgency to previous studies. The 2006 survey did not capture data related to the urgency in needing to hire, and the 2008 survey only used 3 statements relating to urgency: not actively looking, actively looking, and urgent need of another associate. In 2008, 8% of practices were in urgent need of a new hire (2), which is similar to the 12% in the current study.

On the other end of the urgency scale, ~25% of practices looking to hire were relying on veterinarians to approach them, which is twice the number of practices that were in urgent need.
of another veterinarian. Another 17% of the practices already had a potential hire in mind and ~25% of practices were using “word of mouth” as the primary means of attracting another associate. These data underscore the need to be cautious when interpreting employment surveys that merely seek to quantify whether practices are in a hiring mode. Ostensibly the veterinary profession in western Canada had ~300 FTE vacant positions for veterinary associates; however, in reality, only ~40 FTEs vacant positions needed to be filled on an urgent basis. For those looking for employment, it is important to appreciate ~65% of the practices in a hiring mode were not actively advertising; therefore, all practices should be canvassed during a job search.

While the number of vacancies provides a measure of the demand for veterinary associates, a better measure of demand is wages (4). In 2008, the average wage in western Canada was $65 500 (3) compared to $76 700 in the current study. This equates to an annual increase of ~2.65% (5), which is comparable to the rate of inflation in the provinces of Alberta and Saskatchewan (6). These wage data indicate that there is no significant upward pressure on wages, which occurs when the demand for labor (veterinarians) exceeds supply. Rather, the wage data are indicative of a marketplace wherein the supply and demand for veterinarians is near equilibrium. While the marketplace for veterinarians in western Canada appears to be near equilibrium, reports from the United States suggest that the profession may be heading to a future oversupply of veterinarians. The National Research Council’s recent report, Workforce Needs in Veterinary Medicine (2012), “found little evidence of workforce shortages in most fields of veterinary medicine” (7). These findings were confirmed by the American Veterinary Medical Association’s recent report, Implications of the 2013 United States Veterinary Workforce Study: Modeling Capacity Utilization, wherein the authors concluded that the current supply of veterinarians exceeded demand, and estimated that the excess capacity of veterinarians would persist until 2025 (8). If these predictions are correct, then an oversupply of veterinarians in the United States will undoubtedly impact the Canadian marketplace for veterinarians: ~20% of veterinarians in western Canada are foreign-trained (9), many of whom come from the United States. Adding to the supply of veterinarians is the newly established University of Calgary Faculty of Veterinary Medicine (UCVM), which has been graduating ~30 veterinary graduates/y since 2012. These graduates, along with an influx of foreign-trained graduates may explain, in part, why there has been a moderation in demand for new associates.

As per previous studies (1,2,10), the veterinary profession in western Canada is biased towards small animal practice. Approximately 60% of respondents self-identified their practices as exclusively SA and ~77% of all practitioners’ time was spent ministering to small animals. This discrepancy in the percent of practices involved in SA practice and the amount of time practitioners devote to small animals can be reconciled by the fact that the average mixed animal (MAP) practice devoted 60% of practitioners’ time to small animals. This finding confirms anecdotal reports that mixed animal practices have transitioned from being large animal oriented to becoming primarily small animal practices. As the livestock industry continues to consolidate and individual livestock operations expand in size (11), larger producers may increasingly patronize exclusively food animal practitioners versus obtaining exclusively veterinary services from the local mixed practices.

While the 1-person practice remains the most common size of practice, the proportion of 1-person practices is in decline. In 2006, 50% of CA practices were 1-person practices compared to 36% in the current study, and similar reductions have been occurring in MA and FA practices. This movement towards larger multi-person practices may be driven by practitioners seeking to specialize and/or by practice owners looking to become more financially efficient by distributing overhead costs across a larger number of associates. The increase in practice size may also be related to the fact that more veterinarians are choosing to work part-time. The profession is comprised of 60% females, but ~40% work part time. With 80% of graduates being female (12), it is logical to assume that the profession will become increasingly reliant on part-time employees.

Lastly, there was no difference in the hiring intentions of large versus small practices, regardless of how “large” was defined. Previously, larger practices were twice as likely to be looking to hire as were the smaller practices (1). Perhaps this is indicative of the marketplace reaching a point of maturity where those who were actively looking to expand have now reached their optimal practice size.

The trend towards fewer FTE vacancies; a relatively low number of practices in urgent need of veterinary associates; and the moderate rise in base salary all point towards a weakening in the demand for veterinary associates. While we assume that the data from western Canada are reflective of what is occurring in other parts of Canada, it would be informative to have data from central and eastern Canada. Having access to pan-Canadian data would provide a much better portrait of the demographics of the Canadian veterinary profession as well as the supply and demand for veterinary associates. Understanding the demand for veterinarians is of importance because governments and veterinary teaching institutions have been increasing the supply of veterinarians while the demand for new associates appears to be declining.

Acknowledgments

The authors thank Emily Lanigan for her assistance in the administration of the survey. Funding for this project was provided by the Saskatchewan Agricultural Development (ADF) Summer Student research fund and the Western College of Veterinary Medicine’s Interprovincial Undergraduate Student Summer Research Program.

References


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Evaluation of plasma inflammatory cytokine concentrations in racing sled dogs

Dirsko J. F. von Pfeil, Bethany P. Cummings, John P. Loftus, Corri B. Levine, Sabine Mann, Robert L. Downey, Caroline Griffitts, Joseph J. Wakshlag

Abstract — In human athletes significant changes in cytokine concentrations secondary to exercise have been observed. This prospective study evaluated the effect of a multi-day stage sled dog race on plasma concentrations of monocyte chemoattractant protein-1 (MCP-1), tumor necrosis factor-alpha (TNF-α), interleukin-2 (IL-2), interleukin-6 (IL-6), interleukin-8 (IL-8), and interleukin-10 (IL-10). Samples from 20 dogs were harvested prior to and on days 2 and 8 of an 8-day race. Exercise resulted in significantly decreased TNF-α and IL-8 as well as increases of MCP-1, IL-6, and IL-10 concentrations (P-value between 0.01 and < 0.0001 for all parameters). The proportion of values for IL-2 that were below the detection limit increased from 40% on day 0 to 75% on day 2 and decreased on day 8 to 40% (P = 0.04). Racing sled dogs show cytokine-concentration changes that are different from those in humans.

Résumé — Évaluation des concentrations plasmatiques de cytokines inflammatoires chez des chiens de traîneau de course. Chez les athlètes humains, des changements importants des concentrations de cytokines secondaires à l’exercice ont été observés. Cette étude prospective a évalué l’effet d’une course de chiens de traîneau par étapes de plusieurs jours sur les concentrations plasmatiques des protéines-1 chimio-attractives des monocytes (MCP-1), du facteur-alpha nécrotoyant des tumeurs (TNF-α), d’interleukine-2 (IL-2), d’interleukine-6 (IL-6), d’interleukine-8 (IL-8) et d’interleukine-10 (IL-10). Des échantillons ont été prélevés sur 20 chiens avant la course et aux jours 2 et 8 d’une course de 8 jours. L’exercice a produit des valeurs significativement réduites de TNF-α et d’IL-8 ainsi qu’une hausse des concentrations de MCP-1, d’IL-6 et d’IL-10 (la valeur-P entre 0,01 et < 0,0001 pour tous les paramètres). La proportion des valeurs pour IL-2 qui étaient inférieures au seuil de détection a augmenté de 40 % le jour 0 à 75 % le jour 2 et a baissé le jour 8 à 40 % (P = 0.04). Les chiens de traîneau de course montrent des changements de la concentration des cytokines qui sont différents de ceux observés chez les humains.

Introduction

In human athletic endurance medicine, measurement of cytokines is frequently performed to assess potentially negative effects of exercise (1,2). Similarly, as the ultramarathon model, sled dogs may also be negatively affected from exhaustive exercise (3,4). Various cytokines have been suggested to be associated with systemic inflammation and the acute phase response (APR) that could also be involved in muscle damage (5–7). However, to date, only few studies report cytokine concentration changes in racing sled dogs, related to endurance exercise (8,9). In addition, during previous studies the time at which blood was drawn (5 d after starting the race) and the prolonged exercise (over 160 km per day) (8,9) may not have been ideal for assessment of cytokine concentration changes. Furthermore, these endurance events are very different from typical human marathon or ultramarathon endurance racing due to the extreme distance covered. Different blood sampling times in shorter races may reveal additional information related to cytokine release during...
exercise, particularly since the prior studies in endurance racing sled dogs have not shown typical rises in interleukin-6 (IL-6) or interleukin-10 (IL-10) that are commonly associated with exercise (8,9). In human endurance athletes there is typically a rise in IL-6 and other inflammatory cytokines often termed the macrophage 1 (M1) response. This is thought of as a mild inflammation that is followed by a macrophage 2 (M2) response that relates to anti-inflammatory actions through the release of specific interleukins such as interleukin-10 (10,11).

The aim of this study was to determine the effect of daily endurance exercise during a mid-distance marathon stage racing event in racing sled dogs on plasma concentrations of pro-inflammatory cytokines [monocyte chemotactic protein-1, (MCP-1), interleukin-6 (IL-6), tumor necrosis factor alpha (TNF-α), and interleukin-8 (IL-8)], the anti-inflammatory cytokine IL-10 (IL-10) and the lymphocyte stimulating cytokine interleukin-2 (IL-2) using specific novel canine assays before racing, early in the race (day 2) and at the end of the race (day 8). We hypothesized that racing would result in significant changes in measured cytokine plasma concentrations on the different sampling days.

Materials and methods

Mixed breed racing sled dogs (n = 20) from 4 teams (T1 to T4), participating in the 2014 International Pedigree Stage Stop Sled Dog Race were enrolled. The study was approved by the Cornell University Institutional Animal Care and Use Committee (2014-0014). There were 5, 5, 4, and 6 dogs in T1, T2, T3, and T4, respectively. The kennel owners signed a consent form that described the study protocol. A full physical examination was performed on all dogs before the race, with all dogs proving to be healthy. Dogs were fed a mixture of commercial dog food supplemented with meat. The dogs selected for analysis participated in 5 of the 8 total days of the race with all dogs racing on days 1, 2, 8 of the racing schedule. Dogs ran 52 to 75 km per racing day. All dogs were rested on day 3 as a scheduled travel day, and due to weather and trail conditions were also rested on day 7. The average racing time for each stage of the race was 3.5 to 5 h of continuous running with no significant resting periods. Dogs pulled a lightweight sled (80 to 95 kg) that included musher and supplies.

Blood sampling and analysis

Blood was sampled on day 0 between 12 and 1 pm prior to the race, day 2 between 2 and 3 pm and day 8 between 2 and 3 pm. Samples harvested on days 2 and 8 were taken within 30 min of arrival. At each time-point 6 mL of whole blood was collected via cephalic venipuncture using a 22-gauge needle into a 5 mL lithium heparin tube. Blood samples were protected from light and immediately centrifuged at 4000 × g for 10 min. Three aliquots of plasma were immediately stored on dry ice until transportation to the investigators’ lab within 48 h, where they were immediately placed into a −80°C freezer.

Canine cytokine assays

All samples from an individual dog were run on the same plate to eliminate interplate variability. All kits were used according to the manufacturer’s suggestions. The canine MCP-1 enzyme-linked immunosorbent assay (ELISA) was purchased and used within 1 mo of receiving the kits (Millipore, Temecula, California, USA). The interassay and intraassay coefficients of variation (CV) for the assay are 8.6% and 6.9%, respectively, with a lower limit of detection (LLOD) of 16.0 pg/mL. The canine IL-10 ultrasensitive assays were acquired and used within 1 mo of purchase (Mesoscale Discovery, Rockville, Maryland, USA); IL-10 [interassay coefficient of variation (CV) = 19.1%; intra-assay CV = 13.8%; LLOD = 5.9 pg/mL]. The canine electrochemoluminescent multiplexed cytokine kit [Proinflammatory Panel 3 (4-Plex)b] consisted of antibodies against canine TNF-α (interassay CV = 23.5%; intra-assay CV = 6.9%; LLOD = 0.17 pg/mL), IL-2 (interassay CV = 12.2%; intra-assay CV = 9.8%; LLOD = 7.6 pg/mL), IL-6 (interassay CV = 10.6%; intra-assay CV = 10.2%; LLOD = 2.4 pg/mL), IL-8 (interassay CV = 18.6%; intra-assay CV = 5.5%; LLOD = 1.3 pg/mL). Each sample from each sled dog was run in duplicate on the same plate, and a mean value was calculated based on standardized canine controls. All data were examined to assess whether the LLOD was reached. In the case that a LLOD was not met, in an effort to avoid statistical bias, a value was placed on that missing data point as one half of the lower limit of detection (12,13).

Statistical analysis

Due to the skewed nature of many of the data sets, the median and ranges of plasma concentrations of the measured factors were calculated (Microsoft Excel 2013, Redmond, Washington, USA). Data for these parameters were analyzed over time using repeated measures analysis of variance (ANOVA) with the Proc MIXED procedure of SAS (User’s Guide: Statistics Version 9.2; SAS Institute, Cary, North Carolina, USA). Fixed effects were
time, gender, and age. Kennel was included in each model as a random effect. Since measurements were unequally spaced in time, covariance structures tested included spatial (power law, Gaussian, spherical, exponential, linear) as well as unstructured. The covariance structure leading to the smallest Akaike Information criterion was chosen for each analysis. A Tukey’s honest significant difference (HSD) test was performed to account for multiple comparisons when results for the effect of time reached significance ($P \leq 0.05$), least squares means were generated with the SLICE option in the LSMEANS statement of SAS. Because 52% of the values obtained for IL-2 were below the detection limit of the assay, data over time were generated with the SLICE option in the LSMEANS statement of SAS. Because 52% of the values obtained for IL-2 were below the detection limit of the assay, data over time were dichotomized into 2 categories: those values above or below the detection limit. A Chi-square test was performed with the Proc FREQ procedure in SAS to analyze the proportion of samples below the detection limit.

**Results**

Of the 20 sampled racing dogs 10 were male and 10 were female, averaging 3.9 ± 1.9 y of age. Median (range) of plasma concentrations of the measured parameters are listed in Table 1 and results of repeated measures ANOVA in Table 2. All outcome variables were logarithmically transformed to satisfy the model assumptions for residuals. The covariance structure chosen for the analysis of repeated measures was unstructured for MCP-1 and IL-8, power law for TNF-α and IL-6 and exponential for IL-10. The $P$-value for the random effect of kennel was $> 0.10$ in all models. The proportion of values for IL-2 that were below the detection limit increased from 40% on day 0 to 75% on day 2 and decreased again on day 8 to 40% ($P = 0.04$).

**Discussion**

Racing resulted in significantly decreased circulating plasma concentrations of TNF-α, IL-2, and IL-8 on day 2 and significant increases in circulating MCP-1, IL-6, and IL-10 plasma concentrations on days 2 and 8. After the last day of the race, an overall increase to near pre-race circulating plasma concentrations for TNF-α, IL-8, and IL-2 were noted. The elevations of IL-6 and IL-10 and decreases in IL-2 and IL-8 concentrations in plasma are novel in racing sled dogs undergoing this type of racing.

The results of this study being different from prior studies in sled dogs (8,9) may have been influenced by various factors. First, the newer Mesoscale Discovery™ cytokine assays developed for canine species and used in our study appears to have lower sensitivity limits making data more reproducible across duplicates and potentially able to detect small changes that were not possible previously (8,9). Considering the differences in technologies, comparison of our results with past studies has to be performed with caution because past studies used fluorescent bead cytometry technology while the current study used fluorescent ELISA technologies.

Second, the stage stop format of racing with only 3 to 5 h of racing with regular rest periods is vastly different from typical ultra-marathon sled dog races that are up to 1500 km long with erratic exercise and resting periods, in which no changes in cytokines were observed after roughly 450 or 700 km of racing (8,9). In contrast, the dogs herein covered a total distance of approximately 300 km, with daily regular rest periods; this may affect plasma cytokine concentration changes. The early acquisition of samples on day 2, and the extra day of rest on day 7 before the final blood sample after day 8 of exercise may have influenced our results.

Third, it is possible that dogs in our study were trained differently and were exercised to a different level. Intensity of exercise can have a significant influence on the inflammatory response in humans (14). Indeed, trained athletes have shown lesser magnitude of changes in cytokine levels measured prior to and after exercise compared to non-athletes (15) and biochemistry values differed significantly among sled dog teams (16). However, the overall training schedule for these stage race dogs includes 30- to 60-mile runs, averaging 3 times a week. Therefore the exercise they undertook was similar to typical training — unlike endurance racing in which the actual race is often more intense than the pre-racing training regimen. In addition, there was no kennel effect herein: placement of teams were 4th, 9th, 11th, and 12th, suggesting that harder working dogs did not have different elevations of measured cytokines.

Fourth, and importantly, it is unclear if the measured plasma cytokine concentration changes are related to muscular origin, and therefore other sources must be considered. It is well recognized that increased gastrointestinal (GI) permeability and gastric erosions associated with inflammation are observed in competing sled dogs. Defects in gastric mucosa of sled dogs and other working dogs are common and can appear within 1 day of racing (17–19). This may have effects on immune function including increased leucocyte counts and potentially cytokine liberation (3,4). In addition, increased IL-6 concentrations in ironman racing have been associated with both muscular origin and increased GI permeability for endotoxins, resulting in systemic cytokine release, and onset of the acute-phase

### Table 2. Results of repeated measures ANOVA for differences in cytokine concentration over time presented as least squares geometric means and 95% CI. Fixed effects included time, gender and age. Kennel was included as a random effect in all models

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Time 0</th>
<th>Time 2</th>
<th>Time 8</th>
<th>$P$-value for fixed effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCP-1</td>
<td>127.9 (93.6 to 174.8)</td>
<td>412.8 (288.2 to 590.3)</td>
<td>237.8 (161.3 to 350.7)</td>
<td>$&lt;0.0001$</td>
</tr>
<tr>
<td>TNF-α</td>
<td>0.818 (0.490 to 1.345)</td>
<td>0.243 (0.147 to 0.403)</td>
<td>0.935 (0.565 to 1.548)</td>
<td>$&lt;0.0001$</td>
</tr>
<tr>
<td>IL-6</td>
<td>10.27 (6.65 to 15.84)</td>
<td>20.80 (13.49 to 32.08)</td>
<td>20.13 (13.05 to 31.04)</td>
<td>0.01</td>
</tr>
<tr>
<td>IL-8</td>
<td>301.1 (1609 to 5638)</td>
<td>310.9 (194 to 495)</td>
<td>2374 (1460 to 3860)</td>
<td>$&lt;0.0001$</td>
</tr>
<tr>
<td>IL-10</td>
<td>13.29 (4.41 to 40.02)</td>
<td>24.46 (7.79 to 70.66)</td>
<td>17.69 (5.88 to 53.27)</td>
<td>0.006</td>
</tr>
</tbody>
</table>

* Geometric mean, 95% CI — 95% confidence interval.

**Means with different superscript letters differ at level $P < 0.05$ (Tukey’s post hoc test).
response (20). Although no study has evaluated whether there is
an association between increased IL-6 concentrations associated
with erosive ulceration in exercising dogs, this cannot be ruled
out; however, the overall cytokine profile showing decreases in
major inflammatory cytokines (IL-8, TNF-α) with increases in
anti-inflammatory cytokine IL-10 makes this pattern unique
compared with pure inflammatory profiles observed in dogs
with systemic inflammation due to sepsis (21).

None of the dogs in this study were diagnosed with clinical
signs of rhabdomyolysis. Serum CK has been used in the past
to detect exertional problems in sled dogs (23,24) with no con-
sensus regarding its ability to be used effectively to definitively
diagnose rhabdomyolysis, as CK concentrations above the refer-
ence range have also been reported without definitive evidence
of rhabdomyolysis (24). While CK may be overly sensitive, it is
an appropriate screening tool as a biomarker for rhabdomyolysis.
A major limitation of our study was that the detected plasma
cytokine concentration changes were not evaluated in relation-
ship to plasma CK concentrations. However, the relatively small
changes in cytokines suggest that any correlations in this popula-
tion would not have been fruitful. The evaluation of cytokines
in the current study aimed to potentially offer other markers
(MCP-1, TNF-α, and IL-6) that may be more reliable. Yet, with
only 2- to 3-fold rises or decreases in these markers we were
unable to achieve this goal, suggesting that dogs do not have a
similar response to humans during endurance exercise. These
results suggest that sled dogs running similar distances to human
marathon runners do not show prominent rises in inflamma-
tory (IL-6) cytokines, further exemplifying that the (patho)
physiology in racing sled dogs is likely different across species.
Further studies examining endurance dogs early in exercise with
and without exertional rhabdomyolysis may be more revealing.

The most convincing and repeatable evidence of activated
macrophages was the heightened MCP-1 response during
exercise as MCP-1 plasma concentrations more than doubled
on day 2. Increased plasma MCP-1 concentrations are also
described in human marathon runners (5). In contrast to the
only previous study on MCP-1 in racing sled dogs (8), we found
a decrease of plasma MCP-1 concentrations after racing on
day 8 compared to day 2, while an elevated plasma concentra-
tion was maintained at the end of the previous study in which
samples were taken on days 0, 5, and 10. This may be the result
of different distances covered in these races, or the day of rest on
day 7 before the day 8 blood collection in the dogs in this study.

IL-6 concentrations are consistently reported to increase in
human endurance athletes, possibly secondary to hyperventila-
tory hypocapnia (25–27). Exercising muscle is likely the major
source of IL-6 production in humans, supported by higher IL-6
concentrations in muscle compared to circulating blood (27).
For the first time increased IL-6 plasma concentrations in canine
endurance athletes are reported in our study, contradicting pre-
vious results (8,9). However, the IL-6 response is not typically
a sustained response during exercise and these previous studies
may have missed the acute, M1 macrophage-driven response
phase. Although there was a modest increase in plasma IL-6
concentrations on days 2 and 8, we are unsure whether these
are peak concentrations after exercise. The fact that both IL-6
and IL-10 plasma concentrations were elevated may be related
to engagement of the M1 and M2 response, similar to human
athletes, yet at a much lower level with species or fitness level
playing a role in these responses.

Our study is the first to report IL-10 plasma concentrations
in the canine endurance athlete. Besides increased IL-10 con-
centrations, a marked upsurge of additional immunomodulatory
factors such as stress-related catecholamines has been described
in humans, suggesting that each bout of exercise results in an
anti-inflammatory environment (1). However, the latter is
not necessarily true in sled dogs — at least, not to the extent
it occurs in humans (28). The current study is corroborated
by most previous reports from human endurance literature,
in that an increase of IL-10 plasma concentrations is to be
expected as a result of an anti-inflammatory process that takes
place following exercise and is believed to be part of a protec-
tive and regenerative process. The IL-10 plasma concentrations
returned to normal on day 8, possibly related to the natural
M2-response that likely took place during the day of rest on
day 7. This interpretation is supported by the fact that IL-6
plasma concentrations had increased again on day 8, likely a
result of a new M1-response.

Decreases in plasma TNF-α concentration may be related to
the anti-inflammatory cytokine IL-10, reported to inhibit TNF-
α-release (29). Interestingly, we found that on day 2, circulating
TNF-α plasma concentrations were decreased in face of IL-10
plasma concentration increases. Based on this combination and
as previous studies did not find any changes or could not detect
TNF-α (8,9), it is possible that decreased TNF-α plasma con-
centrations are normal in racing sled dogs. The detected rebound
on day 8 could be based on a recovery mechanism similar to that
observed in human ultramarathon runners (26).

IL-8 concentrations in human athletes are typically increased
(5) and the only previous study evaluating IL-8 in sled dogs
reported no significant changes (8). In contrast, we found a
significant decrease in IL-8 plasma concentrations. As IL-8 is
released in response to increased TNF-α (1) and we detected
decreased TNF-α plasma concentrations, this could be an expla-
nation for our findings. Another possible explanation could be
induction of immune regulatory molecules, such as soluble IL-8
receptor, that is attenuated by day 8. In fact, soluble receptors
for IL-6 and TNF-α may attenuate the availability of many of
these cytokines for signaling. IL-2 plasma concentrations for
many samples were below the detectable level in the current
study. A significant decrease was found on day 2 compared to
pre-race values when dichotomizing the samples as either above
or below the detection limit. As in our study, a report on half-
ironman triathletes described IL-2 as hardly detectable pre-race
(2). Interestingly, day 2 showed suppression of inflammation and
this crudely identified decrease in IL-2 plasma concentrations
may be related to immune regulation and decreased lymphocyte
counts, as observed in a study evaluating hematologic changes
in racing sled dogs, since IL-2 is thought to stimulate propaga-
tion of lymphocyte populations (3). IL-2 plasma concentrations
rebounded by day 8, similar to humans (30).

In conclusion, the current study showed that strenuous
exercise in sled dogs induced significant changes in circulating
plasma cytokine concentrations. The sources of these cytokines were not determined.

References


Efficacy of a single-formula acupuncture treatment for horses with palmar heel pain

Katherine A. Robinson, Stephen T. Manning

Abstract — Acupuncture is used without strong scientific evidence to treat many diseases of the horse, including palmar heel pain. Research is needed to provide evidence for the application of these treatments. Within the confines of our study, acupuncture did not reliably modulate palmar heel pain in horses.


Introduction

Palmar heel pain (also known as navicular disease or syndrome) is a common cause of bilateral forelimb lameness; “estimated to cause one third of all chronic forelimb lamenesses in the horse” (1). The syndrome most commonly affects horses over 6 y of age (2,3), although younger horses may also be affected (3). Quarter Horses, some Warmblood breeds, and Thoroughbreds may be overrepresented (3,4). There is no known gender predilection, although at 1 institution, geldings were more likely to be diagnosed (2). The etiology of palmar heel pain remains unknown but 2 main theories, abnormal biomechanical stresses and vascular compromise, have been suggested (3–8). Magnetic resonance imaging (MRI) may be considered the new gold standard of diagnosis, and has allowed for confirmation of the theory that many different osseous or soft tissue abnormalities (alone or in combination) may be affecting the horse with palmar heel pain (3,4,7). Magnetic resonance imaging is not readily available to all equine practitioners and may be beyond the financial means of some clients. Therefore, the diagnosis of palmar heel pain is frequently still based on clinical and radiographic examination. These non-specific diagnostic methods lead to the continued use of non-specific treatments for palmar heel pain, such as corrective shoeing and systemic non-steroidal anti-inflammatory drug administration. Although non-specific with regard to etiology, these therapies are applicable and helpful to many horses with palmar heel pain (3). Acupuncture, a similarly non-specific treatment, may be useful for alleviating the pain experienced by affected horses.

Indeed, acupuncture has been utilized to combat palmar heel pain (1,8,9), although peer-reviewed literature substantiating its efficacy is lacking. However, there is peer-reviewed literature that seems to support the efficacy of acupuncture as a treatment for pain associated with other conditions in the horse (10–12).

Many owners today are looking for non-invasive, drug-free ways to treat their horses. Acupuncture has gained great popularity as a way to provide this service, but there is little scientific evidence to suggest that it is effective for the treatment of palmar heel pain. The aim of this study was to investigate the efficacy of acupuncture for horses affected by palmar heel pain.

Materials and methods

Case selection

Client-owned horses with clinical disease were used for this trial. Horses may or may not have had a previous diagnosis of palmar heel pain and chronicity of lameness was not part of the selection process, although all horses included had a history of chronic forelimb lameness. To be included in the trial, horses had to have a forelimb lameness that was no more severe than a grade 3 out of 5 according to the American Association of Equine Practitioners lameness scale. Perineural analgesia was accomplished using 40 to 50 mg of lidocaine hydrochloride (Lidocaine Neat; Vétoquinol, Lavaltrie, Quebec) per site. Horses could be bilaterally or unilaterally lame,

Department of Large Animal Clinical Sciences, Western College of Veterinary Medicine, University of Saskatchewan, 52 Campus Drive, Saskatoon, Saskatchewan S7N 5B4.
Address all correspondence to Dr. Kate Robinson; e-mail: katherine.robinson@usask.ca
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but needed to have the same blocking pattern on each limb if lameness was bilateral.

Horses were radiographed using 1 of 2 portable, digital X-ray units (truDR ls; Sound-Eklin, Carlsbad, California, USA or uno1; Cuattro Americas, Pekin, Illinois, USA). Horses with radiographic evidence of disease in the proximal interphalangeal joint or distal interphalangeal joint were excluded from the study as it has been shown that a PD block may decrease pain associated with these joints (3). As well, horses with evidence of modeling of the third phalanx were excluded. Acceptable radiographic changes included: modeling of the navicular bone, cyst-like lesions of the navicular bone, enthesophyosis of the navicular bone, dystrophic mineralization of soft tissue structures below the level of the distal interphalangeal joint, and abnormal hoof-pastern angle (as evidenced by “broken back” or “broken forward” angles at the distal interphalangeal joint). Horses were barefoot for the duration of the trial and were trimmed by the same farrier (TB). Anti-inflammatory medications were not permitted for use in the horses during the study period. If an anti-inflammatory drug had been recently administered to a horse that otherwise qualified for the study, a washout period of 2 wk was given (13). Twelve horses met the inclusion criteria, of which 9 completed the study. The study was approved by the University of Saskatchewan's University Committee on Animal Care and Supply.

Of the 9 horses that completed the study, 8 were geldings and 1 was a mare. The ages ranged from 6 to 19 y with a mean age of 14.4 y. Breeds represented included: Paint (n = 4), Quarter Horse (n = 3), Thoroughbred cross (n = 1) and Paint cross (n = 1). Eight of the 9 horses included were bilaterally lame; only 1 horse was unilaterally lame. Owners gave informed consent for the use of their horses in this trial.

**Radiographic evaluation**

Standard radiographic projections were taken as part of the inclusion criteria and then again at the completion of the trial. Views included: lateral-medial, dorsal-palmar, 60° dorsoproximal-oblique (skyline). Radiographs of both forefeet were obtained on each horse at the pre- and post-study assessments.

**Experimental design**

Horses were randomly assigned to the treatment group or the control group. Horses were trimmed to maintain heel mass and decrease breakover (3) and then given a 1 wk adjustment period. The trial period then commenced and was carried out over the next 4 wk. During this trial period, horses were kept in their home environment, on their regular diet, and at their normal level of activity.

Twice weekly visits on non-successive days were made to each horse. Horses in the treatment group received 20 min of dry needle and electroacupuncture at each visit; horses in the control group received no treatment. Acupuncture treatments were administered by a certified veterinary acupuncturist (SM). The same acupuncture points were applied to each horse in the treatment group. Acupuncture treatment points included: Bai Hui, Bladder (BL) 11, BL 13, Pericardium (PC) 1, Heart (H) 9, Lung (LU) 1, and LU 11 bilaterally, and electroacupuncture at Small Intestine (SI) 9 and Large Intestine (LI) 11 bilaterally. Sterile, single use acupuncture needles were used (Seirin Corporation, Shizuoka, Japan). Needle size was similar for all points (0.25 × 40 mm) with the exception of H9 and LU11 (0.25 × 15 mm). Electrical stimulation was provided in a mixed pattern at 2 to 5 Hz using a commercially available electrostimulator (Electro-Acupuncture Stimulator 4C; Pantheon Research, Venice, California, USA).

A second visit was made on the same day but at a different time by a clinician blinded to the treatment (KR). This clinician scored each horse's lameness at each visit based on the AAEP lameness scale and applied electronic calibrated hoof testers developed and validated in our laboratory (unpublished data) to quantify hoof compression threshold (HCT) at 7 sites on the foot: toe, medial quarter, medial heel, lateral quarter, lateral heel, over the frog, and across both heels. Two modified hoof testers were purpose built for this project using strain gauges to measure applied forces. These modified hoof testers were validated on 20 horses with no evidence of musculoskeletal disease, prior to use in the current study. Serial lameness examinations were videotaped for further review.

At the end of the 4-week trial period each horse was given another week off and then lameness examination, blocking pattern, and radiographs were repeated to confirm no changes from the pre-study baseline.

**Data analysis**

Data were not normally distributed; therefore, non-parametric statistics were employed. Lameness grades were compared between groups using the Kruskal-Wallis one way analysis of variance (ANOVA), and HCT data were compared using the Mann-Whitney U-test (IBM SPSS Statistics 20.0, IBM Corporation, Armonk, New York, USA).

**Results**

**Lameness evaluation**

There was no significant difference in grade of lameness between treatment and control animals at initial assessment [right front (RF); P = 0.27, left front (LF); P = 0.66], nor at final assessment (RF; P = 0.44, LF; P = 0.27). All 4 horses in the control group maintained the same grade of lameness through the duration of the study or improved on 1 or both limbs by no more than 1 grade of lameness. Of the 5 horses in the treatment group,
showed improvement of 1 lameness grade on 1 or both limbs, 1 horse did not change, and 1 horse’s lameness worsened through the course of the study. Table 1 presents lameness grades for all of the horses in the trial at the initial and final assessments.

**Hoof compression threshold**

There was no significant difference in HCT’s between treatment and control groups at any of the 7 sites on the foot over the course of the study ($P > 0.05$). For the left front foot, calculated $P$-values ranged from 0.41 to 1.0 over the 7 sites. For the right front foot, calculated $P$-values ranged from 0.56 to 1.0 over the 7 sites.

**Discussion**

Acupuncture did not effectively modulate pain in horses with palmar heel pain under the conditions of the current study. There was no significant difference between horses in the treatment group and horses in the control group with regards to lameness grade or hoof compression threshold. To the authors’ knowledge, there is only 1 study of similar depth published in a peer-reviewed journal investigating the use of acupuncture and electroacupuncture for pain relief in horses with palmar heel pain (9). That study investigated 2 groups of horses; those with laminitis and those with navicular syndrome. In each disease group there were horses that showed improvement with acupuncture treatment but there were no statistically significant differences between treatment groups and controls, regardless of disease process. The current study used similar acupuncture points and treatment protocols and achieved similar results.

The major limitation of the current study includes patient numbers, which reduce statistical power and therefore possibly statistical significance. Our recruitment of eligible horses was greatly limited in that, under the conditions imposed by the Animal Care Committee, horses could not be enrolled in the study if at initial assessment they had a lameness grade of 4 out of 5 or greater on the AAEP Lameness Scale. Had horses with this degree of lameness been able to participate, we would have been able to include significantly more animals in the trial, and a different result might have been achieved.

Another significant limitation is the need to approach clinical trials such that all treated animals received the same treatment. Traditional acupuncture would have each horse diagnosed as an individual and then a specific acupuncture treatment applied as indicated for that individual; having each horse treated in exactly the same way is at odds with traditional acupuncture, and may have limited the efficacy in certain individuals. It would be difficult to design a study that allows for strict, scientific comparisons while using a traditional approach to acupuncture. This core dilemma between science and acupuncture is likely to continue limiting our ability to scientifically assess the efficacy of acupuncture.

The current study utilized electronic calibrated hoof testers to collect quantitative data, rather than force plate analysis, which is typically used for lameness studies (5,14). Electronic calibrated hoof testers are much more accessible to the average practitioner than a force plate for the quantitative evaluation of pain in the foot. Commercial products are available, and the use of hoof compression thresholds in lame horses has been validated (15). As has been previously reported when using calibrated hoof testers, there were few extreme values in the current study, which is evidence that the test is repeatable and consistent. Hoof compression thresholds, whether tested manually or robotically, seem to be a reliable and objective way of assessing foot pain in the horse.

Interestingly, it was noted throughout the course of the study that horses did not test across the heels as consistently as has been historically reported. Horses were much more likely to be positive to hoof testers across the toe, which may be a consequence of repeated overloading (3).

Lameness grade did not significantly change through the course of the study. Other researchers claim that palmar heel pain is a stable lameness with no significant variation over days or weeks (14). This lends credibility to our serial lameness scoring, and the fact that acupuncture did not appear to make a significant difference in level of comfort to the horses receiving that treatment.

In conclusion, acupuncture does not appear to be effective in relieving palmar heel pain in horses. A larger study and the use of MRI for more specific inclusion criteria may lead to different results.

**Acknowledgments**

We express our gratitude to research students Ben Lobb and Lindsay Rogers, our farrier Todd Bailey, the clients who allowed us to use their horses, Drs. Nora Chavarria, Sue Ashburner, Andrea Plaxton, Rochelle Lewis, and Holly Sparks for sending cases to us, Dr. Tawni Silvery for her assistance in interpreting radiographs, Deanna White and all the other students who assisted with this project. Special thanks to Dr. Scott Noble, of the University of Saskatchewan’s College of Engineering, for designing, building, and calibrating the electronic hoof testers used in this study and other ongoing research. The research was funded by the Equine Health Research Fund of the University of Saskatchewan.

**References**

Missing Microbes. How the Overuse of Antibiotics is Fueling our Modern Plagues


This is a very important book by an erudite medical microbiologist, renowned for his work on Campylobacter and Helicobacter. Martin Blaser has been President of the Infectious Disease Society of America and Chair of Medicine at New York University, where he now directs the Human Microbiome Program. It’s important to highlight his blue-chip credentials because his message could be dismissed as utterly cranky. It seems to be being resisted by the medical establishment, but the evidence is accumulating, and the tide is turning and may soon reach rip-tide. It’s a book about the flip-side of the antibiotic miracle.

As a successful infectious disease physician researcher, Dr. Blaser is steeped in understanding of the revolutionary impact of antibiotics as the basis of modern medicine as well as with the problems of antibiotic resistance as microbes fight back. However, he asks whether antibiotics have a biological cost as well as their clear benefits. He then takes us through a tour of some of the modern human “plagues,” which may well have antibiotic use as important and perhaps critical initiating factors. The list is daunting, and perhaps incomplete: allergies and asthma, autism, celiac disease, Clostridium difficile, Crohn’s disease, type 1 diabetes, eczema, gastric reflux and oesophageal cancer, inflammatory bowel disease and irritable bowel syndrome, and obesity. He presents compelling evidence, based on both medical epidemiological studies and on experimental infections in mice, for these associations, many very strong.

The basis of Blaser’s hypothesis is that humans have co-evolved over the millennia with their microbial flora, especially in the large bowel, which has a critical role in normal development and function. Things that interfere with the normal microbiome may have profound effects. The use of broad-spectrum orally administered antibiotics has the effect of a nuclear weapon on the microbiome. Blaser’s hypothesis is, however, not just about the adverse impacts of antibiotics. He presents compelling evidence that caesarian section, which prevents the normal acquisition during birth of the mother’s vaginal flora and seeding of the baby with the bacteria essential for successful intestinal colonization by other bacteria, can have long-term adverse consequences on the child. Early intestinal colonization by our normal microflora is increasingly recognized as a critical part of how we start to train our developing immune system to recognize what is dangerous from what is not. There are as many neurones in the intestinal tract as there are in the brain, and increasing evidence of the important link between the two mediated by the intestinal microbiome, so that the microbiome can affect the developing brain.

For someone who pioneered our understanding of Helicobacter pylori in gastroduodenal ulcers and stomach cancer, it was a wake-up call when Blaser discovered that having virulent Helicobacter decreases a person’s chance of developing asthma by 40% and protects against celiac disease. Infants receiving antibiotics in their first year of life are at increased risk of developing asthma by the time they are seven. Children who have early inflammatory bowel disease are 84% more likely to develop Crohn’s disease than children who don’t; the risk goes up 18% for each course of antibiotics. The average American child receives 17 courses of antibiotics before they reach their 20s. Children who receive antibiotics in the first 6 months of life become fatter than those who don’t.

This book is about the other side of the antibiotic miracle. Apart from C. difficile, are we recognizing in veterinary medicine some of the important adverse impacts of antibiotics that are emerging in medicine and discussed in this book? I think not, but we have not been looking. As veterinarians and agriculture grapple with antibiotic resistance and with trying to reduce antibiotic use to where the benefits are both clear and substantial, medicine is starting to recognize the need to develop a totally new relationship with antibiotics. The future lies in recognizing this new relationship and in improved diagnostics so that antibiotics can be targeted to the pathogen, such that treatment has the precision of a laser not of a nuclear weapon. We’ve all got a long way to go.

Reviewed by John Prescott, VetMB PhD, Department of Pathobiology, University of Guelph, Guelph, Ontario N1G 2W1.
Dorsal midbrain syndrome associated with persistent neck extension: Clinical and diagnostic imaging findings in 2 dogs

Sara Canal, Massimo Baroni, Cristian Falzone, Giulia M. De Benedictis, Marco Bernardini

Abstract — Two young dogs were evaluated for an acute onset of abnormal head posture and eye movement. Neurological examination was characterized mostly by permanent neck extension, abnormalities of pupils, and eye movement. A mesencephalic mass lesion was detected on magnetic resonance imaging in both cases. Neurophysiological pathways likely responsible for this peculiar clinical presentation are discussed.


A though relatively uncommon, lesions confined to the mesencephalon are well-described in small animals (1–3). Clinical signs frequently reported in these cases are abnormal mental status, postural reaction deficits, spastic paresis or plegia, propulsive pacing or circling, mydriasis unresponsive to light stimulation, strabismus either ventrolateral or extorsional, and menace deficits without visual impairment (1,4). This combination of signs is sometimes referred to as midbrain syndrome. The most common causes are cranial trauma with midbrain compression and/or hemorrhage, thiamine deficiency, and granulomatous meningoencephalitis (1,2,5,6). Clinical presentation can vary in severity and lateralization depending on the extent, location, and etiology of the lesion (1,4).

In human medicine, lesions affecting the dorsal part of the mesencephalon are responsible for a cluster of abnormalities concerning eye movement, eyelid position, and pupil dysfunction. This condition is called dorsal midbrain syndrome or Parinaud's syndrome. The most common etiologies are tumors of the pineal gland or dorsal midbrain, multiple sclerosis, strokes, and obstructive hydrocephalus (7–9). However, any other lesion in this region can cause this syndrome (7).

This report describes a peculiar clinical presentation of 2 young dogs diagnosed with a dorsal midbrain lesion. Both cases presented with abnormal pupils, abnormal eye movement, and permanent neck extension.

Case descriptions

Case 1
A 3-month-old intact male German shepherd dog was presented with a 2-week history of abnormal posture of the head (persistently tilted upward) and mild divergent strabismus. In addition, an acute onset of bilateral mydriasis had been noticed 2 d prior to the referral. The dog had been treated with prednisone and amoxicillin, without any improvement in clinical signs.

On presentation, general physical examination was unremarkable. Neurological examination revealed a depressed and disoriented mentation status and retrocollis (head persistently held upward) (10). Circling to both sides, tendency to stumble over obstacles and front limb hypermetria were seen at gait analysis. Proprioception was decreased in all 4 limbs. The vestibulocular reflex (VOR) was bilaterally decreased, movements of the eyes were disconjugated and the right eye tended to tilt downward when the head was moved toward the right. Menace response was inconsistent and bilaterally decreased. Pupils were normal in size with bilaterally slowly responsive pupillary light...
reflex (PLR). Dazzle reflex and vision were judged normal as was the rest of the neurological examination (Video 1 — https://www.youtube.com/watch?v=6-rw4Pr8_58&feature=em-upload-owner). Based on the clinical findings, a brainstem lesion, predominantly involving the mesencephalon, was suspected. The main differential diagnoses were malformation/congenital, inflammatory (infectious or immune-mediated meningoencephalitis), metabolic (electrolyte imbalances, thiamine deficiency), and neoplastic (primary or secondary) diseases.

Complete blood (cell) count (CBC) and dynamic bile acids were within normal ranges and the serum biochemical profile was unremarkable except for elevated aspartate aminotransferase [70 U/L; reference range (RR): 10 to 62 U/L] and alkaline phosphatase (394 U/L; RR: 0 to 90 U/L) activities and a mild hyperphosphatemia (2.28 mmol/L; RR: 0.81 to 1.62 mmol/L). All these abnormalities were considered to be related to age and to previous treatment with corticosteroids.

Magnetic resonance imaging (MRI) of the brain was performed with a 0.22 T unit (MrV; Paramed, Genoa, Italy). Spin Echo (SE) T1-weighted (T1W), post-contrast [0.1 mmol/kg body weight (BW) gadoteric acid IV, (Dotarem, Guerbet Laboratories, Milan, Italy)] SE T1W, and FSE T2-weighted (T2W) images were acquired in transverse, dorsal, and sagittal planes. Additionally fluid attenuated inversion recovery (FLAIR) images were acquired in transverse and dorsal planes. A rounded lesion (1.0 × 0.7 cm) was seen at the level of the middle fossa, just caudal to the third ventricle, involving the dorsal part of the mesencephalon. The mass appeared hypointense to gray matter with a hyperintense rim on T2W images, and homogeneously isointense on pre-contrast T1W images. On post-contrast T1W images, the mass was homogenously enhanced (Figure 1). It was considered to be intra-axial in location; however, an extra-axial location could not be excluded. Ventriculomegaly of all 4 ventricles was evident (Figure 1). A periventricular hyperintensity on T2W and FLAIR images was noticed at the level of lateral and third ventricles. Moreover the lesion produced a mass effect compressing and caudally displacing the cerebellum. Differential diagnoses for the mass included neoplasia and granuloma. Additionally, perilesional edema and obstructive hydrocephalus were seen. Given the severity of signs and the location of the lesion, biopsy was not performed. Based on the poor prognosis, the owners declined any further diagnostic tests and elected euthanasia. Upon histopathological examination of the brain, an astrocytic thalamic hamartoma associated with dorsal mesencephalic meningoangiomatosis was diagnosed (11).

Case 2
A 14-month-old intact male Bordeaux mastiff dog was presented with a 1-week history of bilateral ventrolateral strabismus, abnormal posture of the head (persistently tilted upward), and abnormal mental status. An acute onset of bilateral mydriasis was also noticed some days prior to the referral.

On presentation, general physical examination was unremarkable. Neurological examination revealed a disoriented mental status, retrocollis, and ventrolateral strabismus in both eyes. Front limb hypermetria and a tendency to circle to the right were seen at gait analysis. Proprioception was decreased in both hind limbs and slightly decreased in the left front limb. Vestibulo-ocular reflex was abnormal with disconjugate eye movement: the right eye tended to tilt slightly downward when the head was moved toward the right, and did not abduct when the head was moved to the left. Menace response was bilaterally decreased. Mydriasis, absence of PLR, and dazzle reflex were noticed in both eyes. The rest of the neurological
An MRI of the brain was performed with a 0.20 T unit (Vet MR; Esaote, Genoa, Italy). Spin Echo T1-weighted, post-examinations were within normal ranges.

Neurolocalization and main differential diagnoses were the same as for case 1. Routine hematologic and serum biochemical examination was normal (Video 2 — https://www.youtube.com/watch?v=X3FbHfI5jZ4&feature=em-upload_owner). Case 1: Retrocollis was observed both with the dog in the sitting position and during movement. Tendency to stumble over obstacles and front limb hypermetria were seen at gait analysis. Menace response was inconsistent and bilaterally decreased. Vestibulo-ocular reflex was bilaterally decreased, movements of the eyes were disconjugate and decreased; the right eye tended to tilt downward when the head was moved toward the right.

Video 2. (https://www.youtube.com/watch?v=X3FbHfI5jZ4&feature=em-upload_owner) Case 2: Retrocollis and front limb hypermetria were observed during movement. Right circling was moved toward the right. Decreased; the right eye tended to tilt downward when the head decreased, movements of the eyes were disconjugate and decreased; the right eye tended to tilt downward when the head was moved toward the right.

Discussion

To our knowledge, the present report is the first to document this unusual group of clinical signs secondary to a discrete lesion located within the dorsal midbrain. Both cases (Videos 1,2) presented with retrocollis (10), a condition that has to be distinguished from opisthotonus, which is defined as a spasticity of dorsal neck and head muscles and extension of the neck associated with back arching (12). Opisthotonus is usually caused by extensive lesions of the mesencephalon and rostral cerebellum (4). In addition, in cases of extensive mesencephalic lesion, affected patients are usually recumbent and display severe clinical signs, such as extensor rigidity of all 4 limbs, and severe impairment of mental status (4). Indeed the 2 dogs reported here, were ambulatory, mental status was only mildly compromised at the onset of the clinical signs, and the back was not arched.

Retrocollis is described in cats and monkeys with experimentally induced, bilateral lesions of the interstitial nucleus of Cajal (INC) (13–15). This nucleus is located in the tegument of the rostral midbrain, lateral to the Edinger-Westphal nucleus, adjacent to the periaqueductal gray matter (13,14).
Experimentally induced lesions rostral to the INC did not cause impairment of head position, justifying the crucial role of this nucleus (13). The exact mechanism by which a bilateral INC lesion causes this abnormal posture is still unknown. Experimental studies on primates show that INC sends signals to a multitude of targets implicated in the control of head and neck movement (14,15). Fibers originating from this nucleus deploy terminal fields in the first 4 cervical segments of the spinal cord forming the interstitiospinal tract (13–16). Experimental studies on monkeys demonstrate that these fibers target the medial portion, near the border between gray and white matter, but also more laterally in more ventral portions of the anterior horn (Rexed laminae VII and VIII) (14). In the cat these regions of the spinal cord have been shown to contain motoneurons supplying long dorsal muscles of the neck (i.e., splenius, complexus, and biventer cervicis) (16,17). It seems also possible that the INC sends inhibitory projections to other brainstem regions, directly or indirectly, which tonically excite dorsal neck muscles (13,14). Consequently bilateral INC lesions result in hypertonia of these antigravity neck muscles (13,14). Furthermore, Fukushima et al (16) observed that retrocollis remains unchanged in darkness, demonstrating that it also occurs without visual inputs. It appeared soon after the induction of bilateral INC lesions and lasted consistently whether cats were sitting, standing, or walking. Moreover, when cats with bilateral INC lesions drank water from a basin on the floor, the neck remained extended and was not flexed ventrally (13). These observations indicate that head movement is also impaired in INC-lesioned cats (13). In our 2 cases retrocollis was consistently present both at rest and during movement (Videos 1,2).

In case 1 the histopathological examination confirmed the lesion seen at MRI extending from the region of the pretectal diencephalic nuclei to the dorsal portion of the mesencephalon, involving the periaqueductal gray matter and the nearby structures. Given the anatomical location of the INC (13), we assume that it is involved in the disease process. In case 2, bilateral involvement of this nucleus was presumed based on the strong resemblance of the clinical picture and the diagnostic imaging features to case 1, although lacking the histopathological confirmation. Since the INC is described in dogs (18), we hypothesize that the abnormal posture of the neck and the head in both our cases was due to its impairment.

Moreover, cats with experimental INC lesions displayed abnormal gait (13). Although vision was not affected, they tended to stumble over obstacles placed in front of them or to fall from the edge of a table. All these anomalies may be explained by gaze disturbances consequent to the abnormal posture of the head. Both cases showed similar deficits. Additionally, hypermetria, most notable in the front limbs, was seen at gait analysis.

Front limb hypermetria is reported in cerebellar lesions. In both our cases MRI revealed severe compression of cerebellar parenchyma with caudal displacement. However, cerebellar hypermetria is characterized by inability to regulate the rate, range, or force of a movement. In addition, during the stride the limb is usually raised higher than expected by excessive joint flexion due to inhibition of antigravity muscle activity. Additionally, spasticity and intentional tremors are frequently seen during movement in patients with cerebellar lesions (19). Moreover, bilateral INC lesions cause disturbances of head and neck position, and of eye movements (13,16). As well, these deficits may disturb vertical gaze, cause visual impairment, and consequently gait disturbances such as tendency to stumble over objects, falling backwards, and gait disturbances of front limbs (13). The absence of spasticity and intentional tremors at gait analysis in both cases sustains our hypothesis that hypermetria is due to gait disturbances rather than to cerebellar involvement.

In human medicine, lesions affecting the dorsal part of the mesencephalon produce a specific clinical syndrome characterized by abnormalities of eye movement and eyelid position, and pupil dysfunction. The most common conditions associated with this syndrome are pineal region neoplasms, obstructive hydrocephalus, multiple sclerosis, dorsal midbrain infection, arteriovenous malformations, mesencephalic hemorrhages, and infarction (7,8). The clinical picture, referred to as dorsal midbrain or Parinaud’s syndrome, is classically characterized by ocular signs such as light-near dissociation of pupils, eyelid retraction, and vertical gaze disturbances (9). Pupils are usually dilated and PLR is absent or decreased (7–9).

In light-near dissociation, pupils constrict when the patient focuses on a near object (accommodation), but do not constrict when exposed to bright light (20). The functional role of the pupillary constriction during accommodation is poorly understood. Arguably, it may increase the depth of field by reducing the aperture of the eye, and thus reduce the amount of accommodation needed to bring the image in focus on the retina (21). To the best of our knowledge pupil constriction during accommodation has never been demonstrated in veterinary ophthalmology; consequently, light-near dissociation has never been described in dogs and no attempts of evaluation were made in the 2 patients. In case 2 pupils were dilated, while PLR was reduced in case 1 and absent in case 2. A bilateral involvement of the parasympathetic nucleus of the third cranial nerve is thought to be responsible for these anomalies (22).

Upper eyelid retraction, also called Collier’s sign, is well-described in human ophthalmology. In this eyelid anomaly, the sclera can be seen above the cornea with the eyes in the primary position and to a greater extent during upward eye movements (23). This is an accepted medical sign of a midbrain lesion, thought to be due to damage to the posterior commissure levator inhibitory fibers, which originate in the M-group of neurons (24). Collier’s sign has never been described in veterinary medicine. During a careful, retrospective evaluation of eyelid position in videotapes, this sign was recognized in both our cases (Figure 3).

In Parinaud’s syndrome, vertical gaze is impaired due to the lesion in the INC. It is well-documented that the INC is implicated in the control of eye movements in animals (13,14,25). Experimental studies in monkeys and cats show evidence of connection between INC and ipsilateral and contralateral ocular motor and trochlear nuclei (13,14,25). Unfortunately, vertical gaze abnormalities were not investigated in either of our cases.

It is demonstrated that fibers originating from the INC descend within the ipsilateral medial longitudinal fasciculus.
(MLF) to distribute terminal fields in the ipsilateral vestibular complex (mainly dorsal and medial vestibular nuclei) (13,14,26). Both our cases showed impairment of the horizontal VOR, not described in Parinaud’s syndrome. It is reasonable to suppose that in our cases the clinical presentation was different because of the extent of both lesions and mass effect causing involvement of surrounding parenchymal structures. Indeed, we believe that in both cases this deficit could be the consequence of impairment of multiple structures involved in this reflex (INC, oculomotor and trochlear nuclei, and MLF fibers) rather than dysfunction of a discrete center or pathway.

The main limitation of the current study is the incomplete neuro-ophthalmological examination report in both cases, given the retrospective nature of the report. Pupil dysfunction and further subtle abnormalities of spontaneous eye movement could have been better characterized and documented, integrating the clinical picture and consequently making a better comparison with the human counterpart. This is partially justified by the lack of detailed description in veterinary literature of peculiar signs, such as Collier’s sign and saccadic movements, due to discrete lesion in the dorsal mesencephalon.

Although not previously reported in dogs, retrocollis associated with eye movement disorders and pupil dysfunction should be considered strong indicators of a dorsal mesencephalic syndrome and should alert clinicians to promptly localize the lesion and perform the most appropriate diagnostic imaging procedure.

References

Case Report  Rapport de cas

Longitudinal evaluation of diagnostics in experimentally infected young calves during subclinical and clinical paratuberculosis

Rienske A.R. Mortier, Herman W. Barkema, Karin Orsel, Gregory P. Muench, Janet M. Bystrom, Oscar Illanes, Jeroen De Buck

Abstract — Five calves were inoculated orally at 2 weeks of age with a dose of $5 \times 10^9$ colony-forming units of Mycobacterium avium subspecies paratuberculosis (MAP) on 2 consecutive days. Two calves developed clinical Johne’s disease at 12 and 16 months of age after being consistently positive for MAP on fecal culture and antibody enzyme-linked immunosorbent assay (ELISA), starting 2 to 3 weeks and 4 to 5 months after inoculation, respectively.

Résumé — Évaluation longitudinale du diagnostic lors de paratuberculose subclinique et clinique chez de jeunes veaux infectés expérimentalement. Cinq veaux ont été inoculés oralement à l’âge de 2 semaines avec une dose de $5 \times 10^9$ unités formatrices de colonies de Mycobacterium avium sous-espèce paratuberculosis (MAP) pendant 2 jours consécutifs. Deux veaux ont développé la maladie de Johne clinique à l’âge de 12 et de 16 mois après avoir obtenu des résultats constamment positifs pour MAP aux cultures de fèces et à l’ELISA, commençant entre 2 et 3 semaines et 4 et 5 mois après l’inoculation, respectivement.

Can Vet J 2015;56:1266–1270

Johne’s disease (JD), caused by Mycobacterium avium subspecies paratuberculosis (MAP), an acid-fast, resilient, and fastidious bacterium, is a chronic, enteritis-causing disease, mainly in ruminants and is endemic worldwide (1). Cattle are usually infected orally, through feces from a MAP-shedding animal, and when allowed to progress, the disease culminates in death of infected cattle (2,3).

Diagnosis of MAP infection is a challenge, especially in the early stages. Current diagnostics for MAP infection include serum enzyme-linked immunosorbent assay (ELISA), fecal culture, and interferon-gamma (IFN-γ) release assay. These tests all have relatively low sensitivity, although a wide range of values has been reported (4). Postmortem diagnostics include assessing macroscopic lesions, histopathology, and bacterial culture of tissues. Culture of MAP from intestinal tissue samples confirmed by polymerase chain reaction (PCR) is considered to have highest sensitivity for detection of MAP infection (5) and is considered the most specific of all 3 postmortem diagnostic techniques to identify MAP.

During a large experimental infection trial (6), clinical JD occurred in 2 steers that were only 12 and 16 mo old. The aim of this case report was to compare the longitudinal diagnostic profile of the clinically affected calves to the diagnostic profile of the asymptomatic calves. Secondly, the onset of positivity for routinely used diagnostic tests was related to the 4 stages of JD.

Case description

Five male Holstein-Friesian calves were included in a larger experimental infection trial ($n = 56$), examining age and dose-dependent susceptibility to MAP infection in dairy calves (6–8). The calves originated from farms with negative pooled ($n = 5$) fecal samples and a within-herd seroprevalence $< 5\%$ on all cows aged $3 \, \text{y}$ and older, and from heifers or second parity cows that were individually tested and found negative by fecal culture and antibody ELISA. The 5 calves were inoculated orally at 2 wk of age with a relatively high dose $[5 \times 10^9$ colony forming units (CFU) of MAP on 2 consecutive days] of a virulent cattle-type MAP strain isolated from a clinical case in a dairy cow (Cow 69) (6). All 5 calves were relocated to the research facility, in which calves were individually housed, and fed 6 L of gamma-irradiated colostrum collected from cows in...
Two calves had clinical signs of JD. Calf 4 had a chronic pre-inoculation. Its body condition score (BCS) was 2.5 on a scale of 5 (9) and it continued to deteriorate until 14 mo after inoculation (BCS = 2), despite being fed a more nutrient-dense diet. Two weeks later, diarrhea was noticed for the first time in Calf 4 and remained intermittently present until euthanasia at 16 mo after inoculation.

In contrast, Calf 5 had acute rather than chronic clinical signs. When Calf 5 was 16 mo old, it presented with severe abdominal pain, lack of appetite, and diarrhea. It had BCS = 2.5 and a rectal temperature of 39.4°C. Based on clinical examination, rumen impaction/obstruction or mild peritonitis/hardware disease were differential diagnoses. The calf was given cefotiofur (Excede; Zoetis Canada, Kirkland, Québec), meloxicam (Metacam; Boehringer Ingelheim Canada, Burlington, Ontario), a magnet, a vitamin and mineral supplement (Ketamalt; Bimeda-MTC Animal Health, Cambridge, Ontario), electrolytes (V-Lytes; Vétoquinol, Lavaltrie, Québec), mineral oil (Light Mineral Oil; Vétoquinol) per os, and water per os.

Clinical signs decreased 2 d later, but Calf 5 deteriorated on day 3. White blood cell, hematocrit, and platelet counts (Days 4 and 7) were within normal ranges. On serum chemistry, Calf 5 had hypoproteinemia [51 g/L; reference range (RR): 67 to 75 g/L], the albumin/globulin ratio was low (0.5, RR: 0.8 to 0.9), phosphorus was elevated (2.42 mmol/L; RR: 1.29 to 2.32 mmol/L), and calcium was just below the normal range (2.11 mmol/L; RR: 2.18 to 3.10). As clinical signs did not improve, Calf 5 was euthanized 7 d after the first signs occurred.

Both Calfes 4 and 5 were positive for MAP-specific ELISA [IDEXX Laboratories, Westbrook, Maine, USA; a sample to positive (S/P) ratio > 60 was considered positive] as of 5 and 4 mo after inoculation, respectively, and the ELISA S/P ratio remained high every month until necropsy (Table 1). Fecal culture (para-JEM automated MAP culturing; para-JEM®, TREK Diagnostic Systems, Cleveland, Ohio, USA) was initially positive at 2 and 3 wk after inoculation for Calfes 4 and 5, respectively, and remained positive until necropsy (Table 2). The IFN-γ release assay was performed monthly by stimulating peripheral blood mononuclear cells (PBMC’s) with protein purified derivative avian (Prionics, La Vista, Nebraska, USA) and positive (poxweed mitogen; Sigma-Aldrich Canada, Oakville, Ontario) and negative (PBS) controls were included. The IFN-γ produced by the PBMC’s after stimulation was measured with a commercial INF-γ ELISA (Bovigam®; Prionics). An algorithm (10) for interpretation of test results was used to determine viability of a sample, and a cut-off was used to determine whether a sample was positive or negative (11). A cellular immune response was present in Calf 4 and remained intermittently present until euthanasia at 16 mo after inoculation.

Table 1. Antibody-ELISA results for 5 calves inoculated at 2 wk of age with Mycobacterium avium subspecies paratuberculosis

<table>
<thead>
<tr>
<th>Interval PI (months)</th>
<th>Calf 1 S/P</th>
<th>Calf 2 S/P</th>
<th>Calf 3 S/P</th>
<th>Calf 4 S/P</th>
<th>Calf 5 S/P</th>
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a After inoculation.
S/P%: Signal to positive control percentage.
Clinical signs were present.

Table 2. Fecal culture results for 5 calves inoculated at 2 wk of age with Mycobacterium avium subspecies paratuberculosis

<table>
<thead>
<tr>
<th>Interval PI (months)</th>
<th>Asymptomatic calves</th>
<th>Calf 1 S/P</th>
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<th>Calf 3 S/P</th>
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detected in both calves at 2 mo after inoculation and IFN-γ production remained high until 6 mo after inoculation, after which it declined.

Calves 4 and 5 were euthanized at 16 mo of age, due to animal welfare concerns. Macroscopic lesions were assessed by a veterinarian pathologist (blinded to their inoculation status) and assigned to categories, as described (6): 0 = no macroscopic changes; 1 = 1 enlarged or edematous lymph node of the small intestine or liver; 2 = multiple enlarged and edematous mesenteric lymph nodes and/or hyperemia of the ileocolic valve; 3 = enlarged mesenteric lymph node(s) and/or mild to moderate thickening of ileal or jejunal mucosa; and 4 = enlarged mesenteric lymph node(s) and severe thickening and corrugation of the ileal, jejunal and colon mucosa.

Most sampled tissues were MAP culture-positive, except for 6 and 5 tissues in Calves 4 and 5, respectively. For Calf 4, the 6 tissues that were culture-negative were liver, kidney, spleen, rectum, ileocaecal LN, and duodenum. For Calf 5, the 5 tissues that were culture-negative were liver, kidney, spleen, distal jejunal LN, retropharyngeal LN, and duodenum. Consequently, both calves were assigned to tissue culture category 3 (6).

Based on gross lesions, histological findings and tissue culture results, in combination with other diagnostic tests, both calves were regarded as having clinical JD.

### Asymptomatic calves

Three calves concurrently inoculated at the same age and with the same dose of MAP did not have clinical signs. One of these 3 calves (Calf 1) remained antibody ELISA-negative, one developed a transient response (Calf 2), and the third (Calf 3) became ELISA-positive 10 mo after inoculation (Table 1). The calf with the transient response (Calf 2) was ELISA-positive between 7 and 13 mo after inoculation (Table 1).

Fecal shedding was confirmed in all 3 asymptomatic calves (Table 2). Calf 1 was MAP fecal culture-positive twice at 1 and 3 mo after inoculation; Calf 2 was positive 6 times at 1 to 5 and 11 mo after inoculation; and Calf 3 was positive 13 times at 0.75 to 3, 5, 7 to 8, and 11 to 17 mo after inoculation (Table 2).

An IFN-γ response was detected in Calves 1 and 2 as of 2 months after inoculation, and in Calf 3, as of 3 months after inoculation.

Gross lesions were less severe than in the clinical cases (Table 3): Calf 1 was assigned to Category 2 (multiple enlarged and edematous mesenteric LNs and/or hyperemia of the ileocecal valve), whereas Calves 2 and 3 were assigned to category 3 (enlarged mesenteric LN(s) and/or mild to moderate thickening of ileal or jejunal mucosa; Table 3). Compared to the calves with clinical JD, all 3 calves were in a lower category for gross lesions, histology and tissue culture (0, 2 and 5 tissues were culture-positive; Table 3).

### Discussion

Even though a recommended bovine challenge dose of $5 \times 10^9$ CFU (13) was given on 2 successive days at 2 wk of age, 2 of 5 calves developed clinical JD at 16 mo of age. Clinical disease is not typical at this age and might indicate that an excessively high dose was used for inoculation (13). However, because 3 of the calves infected with the same dose and housed under similar conditions remained asymptomatic, we inferred that inherent

### Table 3. Pathology scores and tissue culture-positives in 5 calves inoculated at 2 wk of age with Mycobacterium avium subspecies paratuberculosis

<table>
<thead>
<tr>
<th>Gross lesion category&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Histological category&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Tissue culture category&lt;sup&gt;c&lt;/sup&gt;</th>
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<td>Calf 1</td>
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<td>1</td>
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<tr>
<td>Calf 2</td>
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<td>1</td>
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<tr>
<td>Calf 3</td>
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<td>0</td>
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<tr>
<td><strong>Calves with clinical signs</strong></td>
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<tr>
<td>Calf 4</td>
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<td>3</td>
</tr>
<tr>
<td>Calf 5</td>
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</tbody>
</table>

<sup>a</sup> 0 = no macroscopic changes; 1 = 1 enlarged or edematous lymph node of the small intestine or liver; 2 = multiple enlarged and edematous mesenteric lymph nodes and/or hyperemia of the ileocolic valve; 3 = enlarged mesenteric lymph node(s) and/or mild to moderate thickening of ileal or jejunal mucosa; and 4 = enlarged mesenteric lymph node(s) and severe thickening and corrugation of the ileal, jejunal and colon mucosa.

<sup>b</sup> 0 = no lesions; 1 = focal lesions; 2 = multifocal lesions; and 3 = diffuse lymphocytic, multibacillary or intermediate lesions.

<sup>c</sup> 0 = no positive tissues; 1 = 1 to 3 tissues culture-positive; 2 = 4 to 6 tissues culture-positive; and 3 = > 6 tissues culture-positive.
individual differences, possibly genetic, resulted in early clinical signs. Although sourcing from positive farms and infected dams was avoided as much as possible, in utero exposure of some of the calves cannot be ruled out and might have given rise to individual variation. Variation in time to progress to the clinical stage has been described; sometimes, the clinical stage is reached as quickly as 6 mo after first fecal shedding (14). Differences among animals that do or do not progress to the clinical stage are critical in clarifying mechanisms of susceptibility/resistance to JD. A genetic basis for resistance/susceptibility to MAP infection has been described in deer (15). A wide genetic variation in dairy cattle has also been related to MAP infection status (16), as well as specific genes such as NOD2/CARD15 (17), and Toll-like receptor TLR1 (18) and TLR2 (19) genes are involved in the initial immune response (20). Heritability of resistance to MAP infection can be up to 12% (21), and heritability of fecal shedding ranged from 16% to 23% (22) and up to 27% in the most recent report (23). Presence of antibodies has a heritability of 9% to 10% (24). A true genetic effect on susceptibility can also be assumed in this case, because environment, management, and bacterial inoculum were similar for all 5 calves in this study. Furthermore, it is noteworthy that the calves were derived from 4 farms with calves 1 and 3 originating from same farm, which increases the probability of genetic variation.

This is apparently the first report to document progression of an infection of cattle with MAP to clinical JD with monthly results from commercial diagnostic tests, ultimately combined with necropsy data (including gross and histological lesions and tissue culture). Due to such intense monitoring, it was possible to determine the exact duration of each stage of MAP infection for these 2 calves. In the “silent infection” stage (stage I), calves, heifers, and young stock up to 2 y of age are infected with MAP, but lack clinical signs (3). Diagnostic tests are consistently negative and the only way to detect such an infected calf is by histology or tissue culture (Table 3). In Calves 4 and 5 (with clinical signs), this first stage lasted 2 and 3 wk, respectively, followed by onset of fecal shedding (beginning of subclinical stage). In these 2 calves, the “silent infection” stage was short; however, under field conditions, the interval from onset of infection to first detectable fecal shedding of MAP is variable (usually > 2 y; 14). In asymptomatic calves, the “silent infection stage” lasted 3 to 4 wk, until the start of fecal shedding (Table 2), a similar timespan as in the clinical calves. It was noteworthy that fecal shedding was consistently the first diagnostic test to be positive, even before the IFN-γ release assay, in all 5 calves before or at 1 mo after inoculation. This early shedding was described previously in experimental infections in goats and calves (25–28). One of the asymptomatic calves (Calf 3) had a persistently positive ELISA response as of 10 mo after inoculation (Table 1) and shed MAP persistently as of 11 mo after infection (Table 2). We believe that if the duration of the trial had been longer, this calf could have become clinical as well.

Subclinical disease (Stage II) typically includes adult cattle without visible signs of JD (3), although antibodies may be present and a cellular immune response detected (3). In this stage, fecal culture is positive or negative (3), and if lactating, milk production will decrease (29–31). This subclinical stage can vary from 6 mo to several years (14). The second stage lasted 11 and 14.5 mo in Calf 4 and Calf 5, respectively. In the asymptomatic calves, this stage lasted from the first fecal shedding (Table 2) to the end of the trial (the actual length of this stage could therefore not be determined in these asymptomatic calves). However, each asymptomatic calf had a distinct antibody response profile (negative, transient response and persistently positive; Table 1); furthermore, fecal shedding patterns in asymptomatic calves were also variable during this subclinical stage.

It is not known why duration of the stages differed between asymptomatic and clinical calves. Probably, calves with early clinical signs failed in their initial cellular immune response, even though such a difference was not detected with the IFN-γ release assay, as described in deer (15). Consequently, invading MAP was not controlled and a higher bacterial burden was established in the intestines of clinical calves. Perhaps a disruption in this cellular immune response enables progression of infection, as suggested in studies on genetic variability discussed above and on immune responses in paratuberculosis (31–33).

Clinical disease (Stage III) usually starts 2 to 10 y after infection; typical clinical signs include gradual weight loss, diarrhea, and changes in serum biochemistry (3). Concurrently, diagnostic tests (including positive fecal culture and ELISA) clearly indicate a MAP infection. This stage typically lasts 3 to 4 mo (3). The duration of this stage was 4.5 mo in Calf 4, but only 1 mo in Calf 5. As the calves were euthanized at this point, the clinical stage was terminated prematurely and the actual duration of this stage could not be determined. It is believed that bacterial dissemination occurs during the clinical stage (3), as must have occurred in these calves since most tissue samples were positive. However, in other calves included in this study, multiple tissue locations were positive in the absence of clinical signs (subclinical stage) indicating dissemination of MAP might occur prior to the clinical stage (6,14,34).

Advanced clinical stage (Stage IV) is characterized by a lethargic state, weakness, emaciation, clinically visible hypoproteinemia (bottle jaw), and diarrhea (3). However, these clinical signs were not observed in the 2 calves described in this article.

It is noteworthy that in this study there were only 2 clinical cases after 5 calves were inoculated with a relatively high dose at 2 wk of age. However, no clinical disease was noted in calves inoculated at 2 wk with a low dose of MAP or any other ages (3, 6, 9, or 12 mo of age) with both doses of MAP in the same trial in which all animals were necropsied at 17 mo of age (6). This was consistent with published studies suggesting that the rate of progression of JD is MAP-dose dependent, in addition to being dependent on age at infection (35).

The inoculation dose used in the infection trial was intended to mimic ingestion of MAP which may occur naturally from contact with infected dams, shedding animals, and resulting environmental contamination. However, little is known about the exact number of MAP bacteria present in and around a typical MAP-infected dairy farm. Infection can be established in young calves with a dose contained in 2 g of feces (31). Nevertheless, the number of CFUs present in these 2 g remains to be determined and is highly dependent on the infection status.
of the source animal. Consequently, the dose with which calves are generally infected on farm remains unknown.

In conclusion, the 2 steers (euthanized at 16 mo of age) were exceptional clinical JD cases. The silent infection stage lasted up to 1 mo in clinical as well as asymptomatic calves. The subclinical stage was relatively short in the 2 steers with clinical JD, but of unknown length in the asymptomatic calves. Diagnostic profiles clearly differed between clinical and asymptomatic calves: clinical calves were consistently positive on ELISA and fecal culture long before appearance of clinical signs, whereas asymptomatic calves had an intermittent shedding pattern and variable ELISA profiles. Whether this difference in diagnostic profile had a genetic basis remains to be confirmed.

Acknowledgments

The authors thank Amanda Nicol, Sandeep Arwal, Uliana Kanevets, Alicia Parfett, Erin Vernoon, Michelle Drissler, Lee Head, and Gwendolyn Roy for technical assistance. The authors also thank numerous undergraduate students from Utrecht University for their dedication to the project and Dr. John Kastelic for editing the manuscript.

References


Evaluation of coagulation via thromboelastography in healthy horses administered dexamethasone

Jenna Woodman, Catherine R. Wagg, Søren R. Boysen, Renaud Leguillette, Kyle Mizen, Marie-France Roy

Abstract — Dexamethasone was administered to healthy horses daily for 7 days. Blood samples were collected at 3 time points from both treatment and non-treatment groups, and analyzed via thromboelastography (TEG). There were no significant differences in TEG parameters between treated and untreated horses, or within treatment groups over time.

Résumé — Évaluation de la coagulation par une thrombo-élastographie chez des chevaux en santé ayant reçu de de la dexaméthasone. La dexaméthasone a été administrée à des chevaux en santé pendant 7 jours. Des échantillons de sang ont été prélevés à trois moments auprès des groupes de traitement et des groupes sans traitement et ensuite analysés par thrombo-élastographie (TEG). Il n’y avait aucune différence significative dans le temps pour les paramètres TEG entre les chevaux traités et non traités ou à l’intérieur des groupes de traitement.

Glucocorticoid therapy increases clotting factors in humans (1) and is associated with increased clot strength in canine blood (2,3). Canine and human patients with naturally occurring hyperadrenocorticism are more likely to develop thromboembolic disease (4,5). Thromboelastography (TEG) is a whole-blood viscoelastic coagulation assay that has been used to demonstrate hypercoagulable states in dogs (2). Thromboelastography has been validated for use in dogs, cats, and horses (6–8).

Dexamethasone is used in equine practice to treat a variety of conditions, including non-infectious respiratory diseases such as recurrent airway obstruction (9). Despite their common use, there are no studies looking into the effects of corticosteroids on coagulation in horses.

The objective of this study was to investigate exogenous glucocorticoid (dexamethasone) administration on coagulation of equine blood. We hypothesized that healthy horses administered dexamethasone would have a hypercoagulable TEG tracing compared with untreated horses, and that dexamethasone treated horses would show evidence of hypercoagulability compared with baseline values.

Ten healthy adult horses were used. Animal Care Committee approval was obtained. Horses were assessed as healthy based on history, physical examination, complete blood (cell) count (CBC) and serum biochemistry. Horses were housed on pasture prior to the study and during the washout period, and in outdoor pens during the sampling period. A 3-day acclimation period to pens was provided prior to taking baseline samples. Diet consisted of mixed grass hay (alfalfa, brome, and fescue) q12h. Horses had ad libitum access to water.

This was a blinded, randomized, controlled crossover study. Each horse was randomly distributed into 1 of 2 treatment groups for Phase 1. Twenty-four hours following baseline sampling, the treatment group received dexamethasone (Dexamethasone 5; Dexamethasone Injectable Sterile Solution USP; Vétoquinol, Lavaltrie, Quebec), 0.05 mg/kg body weight (BW), IM, q24h for 7 d while the untreated group received an equivalent volume of sterile saline IM. Injections were given in the cervical region with a BD Precision Glide Needle (20G 3 1/2”) (Becton-Dickenson, Franklin Lakes, New Jersey, USA). Injection site (right or left side) was alternated each day. After a 7-week washout period, Phase 2 was completed as a crossover study. Investigators who administered treatments, sampled blood, and performed TEG analysis were blinded. Blood samples were taken via atraumatic jugular venipuncture using 20 Ga needles [Jorvet Quick Draw Blood Collection Needle (20 G × 1 1/2”); Jorgenson Laboratories, Loveland, Colorado, USA, and BD Vacutainer Standard Yellow Holder (Becton-Dickinson)] and Vacutainer tubes (BD Vacutainer K2 EDTA Plus Blood Collection Tubes and BD Vacutainer Serum Plus Blood Collection Tubes; Becton-Dickinson) 2 h following treatment. A discard sample of at least 7 mL was drawn (BD Vacutainer Serum Plus Blood Collection Tubes;
Table 1. Baseline blood test results (minimum and maximum values) for study horses obtained at the beginning of Phases 1 and 2

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Phase 1</th>
<th>Phase 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red blood cell count (×10^12/L)</td>
<td>Minimum 6.3</td>
<td>Minimum 6.6</td>
</tr>
<tr>
<td></td>
<td>Maximum 8.5</td>
<td>Maximum 9.5</td>
</tr>
<tr>
<td>Hemoglobin (g/L)</td>
<td>Minimum 116</td>
<td>Minimum 120</td>
</tr>
<tr>
<td></td>
<td>Maximum 141</td>
<td>Maximum 154</td>
</tr>
<tr>
<td>Hematocrit (%)</td>
<td>Minimum 33</td>
<td>Minimum 35</td>
</tr>
<tr>
<td></td>
<td>Maximum 40</td>
<td>Maximum 45</td>
</tr>
<tr>
<td>Platelets (×10^12/L)</td>
<td>Minimum 102</td>
<td>Minimum 97</td>
</tr>
<tr>
<td></td>
<td>Maximum 158</td>
<td>(clumping) 456</td>
</tr>
<tr>
<td>White blood cell count (×10^9/L)</td>
<td>Minimum 4.1</td>
<td>Minimum 5.5</td>
</tr>
<tr>
<td></td>
<td>Maximum 8.4</td>
<td>Maximum 11.1</td>
</tr>
<tr>
<td>Neutrophils (×10^9/L)</td>
<td>Minimum 2.05</td>
<td>Minimum 3.08</td>
</tr>
<tr>
<td></td>
<td>Maximum 5.54</td>
<td>Maximum 6.33</td>
</tr>
<tr>
<td>Fibrinogen (g/L)</td>
<td>Minimum 1.71</td>
<td>Minimum 1.87</td>
</tr>
<tr>
<td></td>
<td>Maximum 3.45</td>
<td>Maximum 3.56</td>
</tr>
<tr>
<td>Total protein (g/L)</td>
<td>Minimum 61</td>
<td>Minimum 60</td>
</tr>
<tr>
<td></td>
<td>Maximum 68</td>
<td>Maximum 75</td>
</tr>
<tr>
<td>AST (U/L)</td>
<td>Minimum 234</td>
<td>Minimum 447</td>
</tr>
<tr>
<td></td>
<td>Maximum 621</td>
<td>Maximum 1245</td>
</tr>
<tr>
<td>LDH (U/L)</td>
<td>Minimum 224</td>
<td>Minimum 228</td>
</tr>
<tr>
<td></td>
<td>Maximum 530</td>
<td>Maximum 592</td>
</tr>
<tr>
<td>GGT (U/L)</td>
<td>Minimum 11</td>
<td>Minimum 26</td>
</tr>
<tr>
<td></td>
<td>Maximum 16</td>
<td>Maximum 86</td>
</tr>
<tr>
<td>Total bilirubin (µmol/L)</td>
<td>Minimum 17.9</td>
<td>Minimum 12.3</td>
</tr>
<tr>
<td></td>
<td>Maximum 35.8</td>
<td>Maximum 23.6</td>
</tr>
<tr>
<td>BUN (mmol/L)</td>
<td>Minimum 3.5</td>
<td>Minimum 3.7</td>
</tr>
<tr>
<td></td>
<td>Maximum 6.4</td>
<td>Maximum 6.8</td>
</tr>
<tr>
<td>Creatinine (µmol/L)</td>
<td>Minimum 90</td>
<td>Minimum 77</td>
</tr>
<tr>
<td></td>
<td>Maximum 130</td>
<td>Maximum 94</td>
</tr>
<tr>
<td>Creatine kinase (U/L)</td>
<td>Minimum 215</td>
<td>Minimum 180</td>
</tr>
<tr>
<td></td>
<td>Maximum 583</td>
<td>Maximum 519</td>
</tr>
</tbody>
</table>

AST — aspartate aminotransferase; LDH — lactate dehydrogenase; GGT — gamma-glutamyl transferase; BUN — blood urea nitrogen.

Becton-Dickinson) before collecting 2.7 mL of blood in 3.2% sodium citrate [BD Vacutainer Buffered Sodium Citrate (9NC) Blood Collection Tubes (0.105M ~ 3.2%); Becton-Dickinson] to achieve a 9:1 blood-to-citrate ratio. Thromboelastography analyses were performed on Thromboelastograph Hemostasis Analyzers (TEG 5000; Haemonetics Corporation, Haemoscope Division, Niles, Illinois, USA) by one operator (JW). Blood samples were held at room temperature until time of analysis. Thirty minutes after blood collection, the sample was gently inverted 5 times and 1 mL of citrated blood was added to a kaolin vial. This vial was gently inverted 5 times and 340 µL of the resulting mixture was added to a preheated reaction cup (37°C) containing 20 µL of 0.2 M CaCl₂. Each sample was run in duplicate. Reaction time (R), clotting time (K), angle (α), and maximum amplitude (MA) were recorded.

Two-way repeated measures analysis of variance (ANOVA) with post-hoc Bonferroni were used to compare data between groups for each TEG parameter. One-way repeated measures ANOVAs were used for within-group comparisons and, where a statistically significant difference was found, a post-hoc Dunnett’s was performed using Day 0 as the comparison column. Normality was tested with a Kolmogorov-Smirnov test. A P value < 0.05 was considered significant. Graphpad Prism (version 5) was used for analyses.

All horses were considered healthy prior to beginning each phase. One horse was removed from the study in Phase 1 in accordance with our animal care protocol due to intolerance of venipuncture. A second horse was removed during Phase 2 when it suffered a limb laceration. Data from these 2 horses were removed from analysis. The horses included for analysis consisted of 2 geldings and 6 mares that were 16.9 ± 5.2 (SD) old and weighed 479.4 ± 73.7 (SD) kg. Body condition scores ranged from 5 to 6 out of 9. Breeds included Quarter Horse, Thoroughbred, and Standardbred.

One horse had a mildly decreased red blood cell (RBC) count with hematocrit and hemoglobin concentration within reference intervals (RI) in both study phases (6.3 × 10^12/L and 6.6 × 10^12/L, respectively; Table 1). One horse had a mild neutropenia (2.05 × 10^9/L), and 1 had mild thrombocytosis (456 × 10^9/L) in Phase 1, both of which returned to within RI in Phase 2. Five horses in Phase 1 and 3 horses in Phase 2 had mild hyperfibrinogenemia according to our laboratory RI (2.46 to 3.40 g/L and 3.24 to 3.56 g/L, respectively). Two of these horses had increased fibrinogen in both phases, the remaining 3 horses in Phase 1 and 2 horses in Phase 2 showed increases in fibrinogen in only 1 of the experimental phases. On biochemistry, 6 horses in Phase 1 and all 8 horses in Phase 2 had mild to moderately elevated aspartate aminotransferase (AST) levels (range of increase 405 to 1245 U/L, RI: 180 to 350 U/L). Creatine kinase (CK) was increased concurrently in 3 of these 6 horses in Phase 1, and in 4 of 8 horses in Phase 2. Gamma-glutamyl transferase (GGT) was mildly to moderately increased in 5 horses in Phase 2 only (range of increase 38 to 86, RI: 1.0 to 35 U/L), 4 of which had concurrent increases in AST and CK and only 1 with a concurrent sole increase in AST. Lactate dehydrogenase (LDH) was mildly increased in 2 horses in Phase 2, both of which had concurrent increases in AST, and 1 in CK.

All data for all TEG parameters were normally distributed. Data from Days 3 and 7 were removed from the two-way ANOVA due to missing data points (operator error). There were no significant differences between treated and untreated horses in any of the 4 TEG parameters evaluated (Figure 1). There were no significant differences within the treated or untreated groups over time compared with baseline values.

Our TEG results do not support development of a hypercoagulable state post dexamethasone administration (0.05 mg/kg BW) to healthy horses. These results may be indicative of a true lack of an effect of dexamethasone on coagulation in equine blood at the dose administered, or may be due to lack of analytical power due to small sample size. To our knowledge, there have been no previous studies investigating the effect of dexamethasone administration on TEG parameters in horses. Prior TEG studies looking at the effects of immunosuppressive doses of prednisone in healthy dogs revealed an increase in MA in treated animals (2,3). However, TEG analyses in these studies were performed on citrated whole blood without use of an activator. In addition
to species differences, these studies are difficult to compare to our kaolin activated citrated TEG samples, given the effects TEG activators have on pre- and intra-analytical variation (6,8). One canine study evaluating citrated-kaolin samples in dogs with naturally occurring ACTH-dependent hyperadrenocorticism found evidence for hypercoagulability based on shorter K times, increased \( \alpha \) angles and increased MA (10), but similar findings were not detected in our dexamethasone treated horses. Humans given dexamethasone demonstrated evidence of increased levels of clotting factors and fibrinogen (1). Although a good proportion of the horses in our study showed evidence of mild hyperfibrinogenemia in their baseline blood test results, there were no corresponding significant changes in any of the TEG parameters measured, and more specifically, no significant increases in MA values. Dogs with naturally occurring hyperadrenocorticism were found to have increased fibrinogen concentrations that were associated with increased MA and positively correlated with MA\(_{\text{fibrin}}\) (fibrin portion of MA as detected by TEG platelet mapping) (10), but we did not detect similar changes in MA in our study horses. The hyperfibrinogenemia in our horses was consistently mild, with fibrinogen values never exceeding 4 g/L, which has been reported as the upper limit of reference ranges in healthy horses (11), thus were not likely of sufficient concentration to have affected MA values.

Previous canine studies (2,3) demonstrated a decrease in fibrinolytic parameters (LY60) in dogs administered prednisone compared with their baseline values. Due to time constraints within our sampling protocol, we were not able to consistently obtain values for fibrinolytic parameters in our study horses, but these would be worth including in similar future studies.

It is possible that the dose of dexamethasone used in our study played a role in the inability to demonstrate a hypercoagulable
state. The 0.05 mg/kg BW, q24h dose of dexamethasone was chosen for this study because it is a commonly used therapeutic protocol for inflammatory conditions in clinical practice (10). Considering that laminitis has been identified anecdotally as a consequence of steroid therapy, a dose > 0.05 mg/kg BW, q24h was avoided. It is possible that a higher dexamethasone dose on a mg/kg basis may have resulted in changes in TEG tracings.

A major limitation in this study was sample size. We were unable to use more than 10 horses due to budgetary and logistic constraints. It is possible that repeating the study with a greater number of horses would reduce type II error and result in a significant difference between treated and untreated groups.

There was variability within our TEG parameter results in both treated and untreated groups (Figure 1). This variability could have been due to a combination of effects from pre-analytic factors, breed or gender variations, or potentially the use of multiple machines for analysis. Measures were taken to help decrease this variability: all machines underwent electronic quality control (via E-testing) daily, biologic controls were performed daily prior to running any samples, analyses were run in duplicate to decrease imprecision, and an activator (kaolin) was used to help decrease the impact of pre-analytic factors as recommended by Laursen et al (8). Nonetheless, some degree of variability remained in our results. Future studies with a larger number of animals may increase accuracy of the results and potentially investigate any breed and/or gender differences that may be present.

The mild decrease in RBC count in 1 horse in both phases was not considered clinically significant based on concurrent hemoglobin concentration and hematocrit within reference intervals, and a normal physical examination in this individual. The single isolated mild neutropenia and mild thrombocytosis in 2 separate horses in Phase 1 were also not considered to be clinically significant given their mild degree of change, and their subsequent resolution in Phase II baseline CBC results.

In baseline biochemistry results, the concurrent increases in AST and CK were most likely associated with some degree of muscle injury (12). This could be associated with blood sampling or with horses adapting to new social pairings within their pens; running and/or chasing likely occurred as part of the establishment of social hierarchy prior to blood collection. Blood samples for serum biochemistry were shipped to a local laboratory for analysis, and any delay in separation of serum from cells before submission could have contributed to the increases in AST (12). Increases in GGT and LDH are more difficult to explain. There was investigation into the possibility of hepatotoxic plant exposure during the 7-week washout period while horses were on pasture, but no evidence for this was found. Brief physical examinations were performed daily on each horse prior to sampling and no abnormalities were noted for any of these horses during the study. Steroid hepatopathy could have also been possible (13), but less likely given the 7-week washout period between dexamethasone injections and biochemistry analyses.

In conclusion, based on these preliminary results, the administration of IM dexamethasone at a dose of 0.05 mg/kg BW, SID to healthy horses did not alter TEG parameters, between treated and untreated groups, or at any time point during the course of administration of dexamethasone. Studies involving larger numbers of animals are required to further investigate potential effects of steroids on coagulation parameters in horses.

References

African pygmy hedgehogs (Atelerix albiventris) are popular domestic pets. Neoplasia is a common finding in this species, with tumors identified in up to 50% of middle-aged hedgehogs (1,2). A large proportion of these tumors are malignant, hence carrying a poor prognosis (1). The integument is the most frequently affected location; however, tumors have been described in various body systems (1,3). Most neoplastic processes observed in African pygmy hedgehogs are of epithelial origin, with documented cases of mammary gland adenocarcinoma/carcinoma and sebaceous carcinomas, as well as epithelial tumors of the digestive, endocrine, respiratory, and reproductive systems (1,3–11). Oral squamous cell carcinoma (OSCC) is a common form of malignancy in hedgehogs and usually presents as a locally invasive tumor with a low tendency to metastasize (1,5).

This report describes a case of cutaneous squamous cell carcinoma (CSCC), which to the authors' knowledge has never been thoroughly described in the African pygmy hedgehog.

Case description

A 4-year-old male African pygmy hedgehog was presented to the Exotic Animal Clinic of the Université de Montréal for the investigation of a cutaneous mass growing on the left caudo-dorsal aspect of the neck. The mass was first noted 2 mo prior to initial presentation. The hedgehog had normal fecal production, urine output, appetite, and sleeping pattern according to the owners, but was observed rubbing the mass on several occasions. No diarrhea or vomiting was reported. Housing and dietary management were adequate for the species. No outdoor access was provided.

Upon visual examination, an ulcerated mass on the caudo-dorsal aspect of the neck immediately behind the left pinna was observed (Figure 1A). In order to perform a complete physical examination, general anesthesia was induced with 2% isoflurane (Isoflurane USP; Pharmaceutical Partners of Canada, Richmond Hill, Ontario) in oxygen (2.5 L/min) in a small induction chamber. Anesthesia was maintained via a face mask. The mass measured 35 mm in height with a 25 mm diameter pedunculated base (Figure 1B). Palpation of the mass suggested a cutaneous location without obvious adhesion to the underlying tissues. Other abnormal findings included abundant dandruff and gingival hyperplasia with multiple incisor and premolar teeth missing. The remainder of the physical examination was unremarkable. Prior to recovery, fine-needle aspirates of the mass were performed for cytological evaluation. Skin scrapings and tape preparation were done to investigate the dandruff. Recovery from anesthesia was uneventful.

The most likely differential diagnoses for the mass were an infectious process such as an abscess or granuloma, or neoplasia. Reported tumors involving the integumentary system in...
African pygmy hedgehogs including papilloma, mastocytoma, fibrosarcoma, hemangiosarcoma, lymphosarcoma, osteosarcoma, and carcinoma were included in the differential diagnoses (1,3,5,10,12–14).

Skin scrapings and the tape preparation were unremarkable. Treatment with trimethoprim-sulfamethoxazole (TMS) (Novo-Trimel Oral Suspension; Novopharm, Toronto, Ontario), 30 mg/kg body weight (BW), PO, q12h was administered for 14 d, based on the ulcerated nature of the mass. Cytological evaluation of the fine-needle aspirates was consistent with a keratinized epithelial tumor with secondary inflammation. The most likely diagnosis was a squamous cell carcinoma. Surgical excision of the mass followed by histopathologic examination was recommended.

The hedgehog was again induced with 2% isoflurane in oxygen (2.5 L/min) in a small induction chamber. Butorphanol tartrate (Torbugesic; Wyeth Canada, Guelph, Ontario), 0.1 mg/kg BW, glycopyrrolate (Glycopyrrolate Injection; Omega, Montreal, Quebec), 0.01 mg/kg BW, and TMS (Tribrissen 24%; Schering Canada, Pointe-Claire, Quebec), 30 mg/kg BW were injected subcutaneously prior to surgery. Warm subcutaneous fluid was administered (Lactated Ringer's Injection, USP; Baxter Corporation, Mississauga, Ontario), 30 mL/kg BW. An elliptical incision was created with a margin of 1 cm surrounding the mass. Soft tissue dissection allowed complete excision. Recovery following surgery was smooth and uneventful. Minimal serosanguineous discharge and inflammation were noted at the surgical site the next day. The animal was discharged on meloxicam (Metacam; Boehringer Ingelheim, Burlington, Ontario), 0.1 mg/kg BW, PO, q24h for 7 d and TMS, 30 mg/kg BW, PO, q12h for 14 d.

Gross evaluation of the excised tissue showed an irregular, conical, and exophytic mass (Figures 1A and 1B). On section, it was firm, pale, and had well-defined margins. Another smaller circular mass 0.7 cm in diameter was attached to the base of the exophytic mass and was also pale and well-defined. Both masses were fixed in 10% buffered formalin and embedded in paraffin. Sections 4-μm thick were stained with hematoxylin-eosin-phloxin-saffron (HEPS).

Microscopically, the main epithelial mass was highly cellular, exophytic, and non-encapsulated. It was composed of trabeculae and cords of neoplastic cells invading the dermis (arrowhead). Bar = 300 μm.
papillary projections. These cells were large, polygonal, with prominent intercellular bridges and exhibited progressive keratinization as well as occasional keratin pearl formation. They contained an abundant granular eosinophilic cytoplasm and round to ovoid central nuclei with finely granular chromatin and 1 to 3 basophilic nucleoli of variable size. Anisocytosis and moderate anisokaryosis were noted and rare cells presented megakaryosis. There were 0 to 2 mitoses per 400× field, located mainly in the basal and suprabasal layers. Most neoplastic cells contained 1 to 2 granules of keratohyalin. Keratinocytes presented marked multifocal to confluent spongiosis, ballooning degeneration, and multifocal apoptosis. Neoplastic cells infiltrated the dermis in several locations (Figures 1C, 1D) and islands of keratinocytes dissected among the muscle fibers of the panniculus carnosus, sometimes completely surrounding them. Extensive superficial necrosis and some ulceration of the epidermis were observed, along with mild to moderate inflammation of the epidermis and superficial dermis and, to a lesser extent, the panniculus carnosus muscle. Moderate parakeratotic hyperkeratosis was noted on the tumor and moderate orthokeratotic hyperkeratosis extended into the follicular infundibula of the adjacent skin. The lesion did not extend to the surgical margins.

The smaller circular mass (Figure 1C) was consistent with a follicular cyst. A small number of bacteria and mild multifocal infiltrates of inflammatory cells including lymphocytes, plasma-cytes, and eosinophils were associated with the cyst.

Three months later a rapidly growing mass appeared near the former surgical site. The hedgehog was alert, but food consumption had decreased over the last few days. The owner declined further investigation and the hedgehog was euthanized. Necropsy was not permitted.

**Discussion**

Squamous cell carcinomas of the oral cavity of African pygmy hedgehogs have been well-described; however, there are only brief mentions of SCC in cutaneous locations (13,15). Oral squamous cell carcinoma is the most commonly reported digestive neoplasia in this species and the third most frequent neoplastic process, following mammary gland adenocarcinoma and lymphoma (1,3). Oral squamous cell carcinoma is usually described as a locally invasive tumor, although 1 review mentions a case associated with metastasis to lymph node and lungs (1,3,8). The only detailed reports of CSCC involve other hedgehog species (16,17).

Cutaneous squamous cell carcinoma is a relatively frequent skin tumor in dogs, cats, horses, and humans (18–21). Multiple risk factors have been associated with development of this tumor. Firstly, ultraviolet radiation (UVR) is recognized as an important carcinogen in humans, especially for individuals with light-colored skin, through induction of damage to DNA (20,22,23). Immunohistochemistry studies and epidemiological observations suggest a similar causal relationship in SCCs of the aforementioned domestic animal species (18,19,24–27). Exposure to UVR is unlikely to have been a contributing factor to neoplastic development in the present case, considering the animal was exclusively housed indoors with no reported access to artificial UVR. Secondly, papillomavirus (PV) infection is strongly associated with the development of mucosal SCCs in humans, and may also be linked with non-melanoma skin cancer such as CSCC (28,29). Immunosuppression may act as a co-factor by allowing a persistent viral infection (28,29). Mixed histological lesions, implying concurrent features of viral infection and neoplastic growth coupled with immunohistochemical evidence of PV infection, support an association of PV infection with carcinogenesis in dogs and cats (29–32).

In the case described here, although the macroscopic appearance of the mass was suggestive of an initial papillomatous growth, no lesions suggesting a PV infection were found on histological sections. No support for a relationship between viral infection and papillomatous growth is currently found in the literature on the African pygmy hedgehog (14). Finally, exposure to chemical agents and chronic skin diseases constitute other carcinogenic risk factors in humans (20). Our patient’s history was not supportive of an association with these risk factors.

Necropsy and histopathological examination would have been required to confirm the nature of the recurrent mass observed 3 mo after surgery. A relapsing CSCC was considered the most probable diagnosis at the time of euthanasia, but a postsurgical abscess, benign hyperplasia, or a different neoplastic growth were also considered. Histopathological evaluation of the surgical margins can be used as an assessment of the infiltrative extent of a tumor; however, it cannot guarantee the absence of neoplastic cells in the healthy tissues surrounding the surgical wound. This possibility must be included in the discussion of histopathological results with the client. In humans, factors affecting the relative risk of recurrence and metastasis of CSCC include size, location, growth rate, and association with injured or chronically diseased skin (20) Histologically, depth of neoplastic invasion, infiltration of surrounding tissues and degree of differentiation are also predictive factors (20). In the present case, rapid growth rate, large tumor size and histological evidence of dermal and muscular invasion are suggestive of a higher relative risk of recurrence and metastasis. The follicular cyst resulted from compression of a hair follicle by the adjacent CSCC and was considered incidental.

According to the authors’ review of the literature, this is the first detailed report of a cutaneous squamous cell carcinoma in an African pygmy hedgehog. The tumor was characterized by an exophytic appearance, rapid growth, and an infiltrative pattern. No predisposing risk factors reported in other species were identified in the patient’s history. Local recurrence following surgical excision is strongly suspected. Cutaneous squamous cell carcinoma should be included in the list of differential diagnoses of a cutaneous mass in African pygmy hedgehogs.

**References**


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The Canadian Journal of Veterinary Research (CJVR) is looking for a new editor. After a long and successful time at the helm, the current CJVR editor, Dr. Éva Nagy, is leaving. The Editorial Committee of the CVMA is seeking an individual responsible for the peer-review process for scientific articles in the CJVR. A job description is available by request (hbroughton@cvma-acmv.org).

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Case Report  Rapport de cas

Acute idiopathic polyneuritis with spontaneous remission in an Abyssinian cat

Aurélien Jeandel, Kaspar Matiasek, Stéphane Blot

Abstract — An Abyssinian kitten was presented after a sudden onset of neurological disorders consistent with a polyneuropathy. Electrophysiological and histological investigations revealed an inflammatory polyneuropathy. No infectious agents were detected. Spontaneous recovery occurred rapidly without relapse (2 years follow-up). This is the first description of a histologically confirmed self-limiting feline polyneuritis.

Résumé — Polyneurite idiopathique aiguë avec rémission spontanée chez un chat Abyssinien. Un chaton Abyssinien a été présenté suite à l’apparition soudaine de troubles neurologiques conformes à une polyneuropathie. Aucun agent infectieux n’a été détecté. Le rétablissement spontané s’est produit rapidement sans rechute (suivi de 2 ans). Il s’agit de la première description d’une polyneurite féline auto-limitée confirmée par histologie.

Can Vet J 2015;56:1279–1282

Introduction

Polyneuropathies are rare in cats and particularly in kittens. Their origin can be inherited or acquired (1–5). Acquired polyneuropathies in cats are immune-mediated (6–12), paraneoplastic (7,13), toxic (2,3,7,9,10,14), metabolic (2,3,15), or of unknown origin (6,8,16). Reported self-limiting remission from polyneuropathies in cats is rare and includes demyelinating/remyelinating polyneuropathies in Bengal cats (9,17), axonal neuropathy in Snowshoe cats (1,7), motor polyneuropathies (6,8,10), and undetermined polyneuropathies (6–9,11,18). Histologically confirmed idiopathic inflammatory polyneuropathy (polyneuritis) has been rarely documented in feline medicine (7,9,10), and all reported cats were euthanized due to a worsening neurological status. Here we describe an acute histologically confirmed case of polyneuritis with spontaneous remission without medical treatment and without relapse after 2 y.

Case description

A 6-month-old intact female Abyssinian cat was presented 4 d after the sudden appearance of abnormal gait. Six days before presentation, the kitten had vomited once. Since then, the owners reported reluctance to walk and jump that slowly evolved to pelvic limb weakness. The cat had been vaccinated 3 mo earlier and the last external parasite treatment had been given 2 wk earlier. The kitten had no access to the outdoors, drugs, or plants, and was fed a high quality commercial food. No contact with any other animal was reported.

At the time of presentation, the neurological examination revealed a normal mental status and behavior. The cat sat for most of the time. Pelvic limbs weakness, plantigrade stance, associated with short-strided gait involving just pelvic limbs, and absent flexion of the tarsal joints were clearly apparent (see video file: https://youtu.be/xSAwCJtPySA). No involuntary movement was observed. Examination of the cranial nerves revealed no abnormalities. A proprioceptive positioning response was absent in the pelvic limbs, normal in the thoracic limbs. Hopping was decreased in the pelvic limbs, slightly decreased in the thoracic limbs. Spinal appendicular reflexes were decreased (patellar reflex, thoracic limb flexion) to absent (distal pelvic limb flexion). Mild distal appendicular muscle atrophy was detected. Evaluation of sensory system was unremarkable.

An acute and diffuse neuromuscular disease was suspected from the physical examination. An electrophysiological examination (Nicolet Viasys Viking Select EMG machine; Viasys, Geispolsheim-Gare, France) and neuromuscular biopsies were carried out under general anesthesia and analgesia. Electromyography was performed on the head, paraspinal, and appendicular muscles.
of the left side of the kitten. Diffuse abnormal spontaneous activity (fibrillation and positive sharp waves) was observed in the appendicular muscles. The intensity of this activity was higher in the most distal muscles (plantar and palmar interossei m., tibialis cranialis m., gastrocnemius m., flexor carpi radialis m., and extensor carpi radialis m.). A tibial, fibular, and ulnar nerve conduction study was performed. The amplitudes of the proximal and distal compound motor action potentials were significantly decreased. Sensory and motor nerve conduction velocities were low compared with the published reference intervals for kittens (15) (Table 1). F-waves latency of the tibial nerve was increased and the F-wave ratio was normal compared with published reference (Table 1). F-waves latency of the tibial nerve was increased and compared with the published reference intervals for kittens (15)

Sensory and motor nerve conduction velocities were low compared with the published reference intervals for kittens (15)

<p>| Table 1. Electrophysiological values in the kitten compared with previously published reference intervals (mean ± standard deviation) in young(^a) and adult(^b) cats |
|----------------------------------|-----------------|-----------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th></th>
<th>Proximal CMAP amplitude (mV)</th>
<th>Distal CMAP amplitude (mV)</th>
<th>Proximal CMAP duration (ms)</th>
<th>Distal CMAP duration (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peroneal nerve</td>
<td>2.6 (24.5 ± 10.5)</td>
<td>4.1 (32.8 ± 6.2)</td>
<td>3.3 (3.7 ± 1.2)</td>
<td>1.8 (3.5 ± 0.7)</td>
</tr>
<tr>
<td>Tibial nerve</td>
<td>8.8 (17.8 ± 4.9)</td>
<td>9.0 (26 ± 1.8)</td>
<td>4.8 (8.1 ± 2.5)</td>
<td>2.6 (8.0 ± 2.1)</td>
</tr>
<tr>
<td>Radial nerve</td>
<td>3.8 (26.8 ± 10.1)</td>
<td>6.9 (24.7 ± 5.8)</td>
<td>4.0 (4.9 ± 1.6)</td>
<td>4.0 (3.7 ± 0.8)</td>
</tr>
<tr>
<td>MNCV (m/s)</td>
<td>67 (101 ± 20.4)</td>
<td>65 (84.7 ± 11.1)</td>
<td>12.8 (NR)</td>
<td>NM</td>
</tr>
<tr>
<td>SNCV (m/s)</td>
<td>59 (95.5 ± 9.7)</td>
<td>NM</td>
<td>13.5 (9.5 ± 1.0)</td>
<td>1.72 (1.75 ± 0.2)</td>
</tr>
<tr>
<td>F-wave ratio</td>
<td>80 (83.9 ± 8.0)</td>
<td>62 (75.6 ± 3.6)</td>
<td>10.3 (NR)</td>
<td>1.05 (NR)</td>
</tr>
</tbody>
</table>

\(^a\) Data from references 6, 8, 15.

\(^b\) Data from references 6, 16, 17.

CMAP — compound muscle action potential; MNCV — motor nerve conduction velocity; SNCV — sensory nerve conduction velocity; NM — not measured; NR — not reported.

Figure 1. Tibialis cranialis muscle histology. A — Grouped multiple small angulated fibers (Hematoxylin and eosin stain, bar = 100 μm); B — Intramuscular nerve branch in a normal 8-month-old cat (Gomori’s trichrome stain, bar = 10 μm); C — Intramuscular nerve branch of the kitten (Gomori’s trichrome stain, bar = 10 μm).

Figure 2. Nerve immunostaining was not possible due to a lack of tissue. A diagnosis of polyneuritis was established. Lumbar cerebrospinal fluid (CSF) cytological examination (red blood cells 920/mm³, white blood cell 1/mm³, 0 after centrifugation) and CSF total protein (0.23 g/L) were unremarkable. Serum biochemistry and urine analysis were normal, and serum creatine kinase was normal (375 UI/L, reference range: 641 to 700 UI/L). Serum protein electrophoresis revealed an alpha-2 globulin increase. Tests for serum feline immunodeficiency virus antibody and feline leukemia virus antigen were negative. A Toxoplasma IgM titer was negative and IgG titer was slightly positive suggesting past exposure (1:64, normal < 1:32). Thoracic radiographs and abdominal ultrasound images were unremarkable. An idiopathic polyneuritis was diagnosed from these results.

A slight improvement of the gait was observed the following day, without treatment. After a week the patient still showed pelvic limb weakness but was not reluctant to walk anymore. Postural reactions were normal for the thoracic limbs but still diminished for the pelvic limbs. Spinal reflexes were still diminished for the pelvic limbs, normal for the thoracic limbs. Two weeks later, the gait was normal according to the owner. Six months later, a clinical follow-up confirmed the normal neurological examination. Toxoplasma IgG titer was negative. Two years after the onset, no relapse was reported by the owner.
Figure 2. Teased peroneal nerve after osmium tetroxide with/without hematoxylin counterstaining. Note the mononuclear round cells attached to (red arrows) or invading (blue arrows) the large myelinated fibers (bar = 20 μm).

Discussion

To our knowledge, this is the first histologically confirmed description of an acute self-limiting idiopathic polyneuritis in a kitten. In young animals, congenital or degenerative diseases can be suspected. In our case, a polyneuritis was identified histologically. Nerve pathology in inflammatory polyneuropathies has rarely been described in feline veterinary medicine (7,9,10,19). Two of the 4 described cases were based on postmortem examination of an acute form in an adult. In the first case (9), extensive destruction of myelin with macrophages and lymphocyte infiltrates was observed in the distal peripheral nerves, but the spinal nerve roots were not examined. In the second case (7), demyelination and accumulation of macrophages were observed in the ventral roots of the spinal cord and in all nerves. The third case concerned a chronic disease (10), with segmental demyelination, remyelination, and focal mononuclear cell infiltration of the dorsal and ventral spinal roots. Distal nerves showed less severe alterations. More recently, severe mononuclear nerve infiltration has been described in a cat with steroid responsive idiopathic polymyositis and polyneuritis (19). In our case, the semi-thin longitudinal sections were unremarkable, whereas the teased fiber preparation showed mononuclear cell adhesion and invasion but no concurrent features indicative of demyelination. Fiber-invasive cells entering the myelin tube is described in immune-mediated polyneuropathies in humans (20). Nerve fiber immunohistochemistry is necessary to confirm the nature of the infiltrates, but this was not possible due to the small amount of tissue. Despite minimal nerve fiber abnormalities, intramuscular nerves showed fiber loss. This finding could indicate a distal polyneuropathy. Ventral nerve root biopsies were considered, but not done due to the associated risks and the observation that the cat was already showing signs of improvement.

Histopathological diagnosis of polyneuritis is rare and often this disease is considered idiopathic in cats (7,9–12,19). Tests for Toxoplasma gondii, feline immunodeficiency virus, and feline leukemia virus did not detect any of these infectious agents in our kitten. Evolution of the disease in this cat was acute and self-limiting. Acute acquired polyneuropathies have been previously reported (6–9,11,18). In a case series of 9 cats with acute polyneuropathies (2–5,7), all the cats were middle-aged, except 1 which was 4 mo old. Two of the cats were euthanized due to worsening of the clinical signs; the other 7 cats were discharged without medication and made a full recovery within 4 to 6 wk, without any relapse during the following 2 y. The diagnosis of polyneuropathy was only clinical in 8/9 cats, and postmortem in 1 cat due to its worsening condition. Self-limiting evolution, or recurrent acute polyneuropathies have been identified in young Bengal and other breeds of cat (1,6,8,17). None of the histological examinations reported an inflammatory process. In another case report of acute polyneuropathy (7,9–12), improvement was observed after a few weeks of prednisolone therapy. Our case report confirmed that idiopathic acute polyneuritis could resolve spontaneously with no relapse over a 2-year period.

In our cat, the electrophysiological examination was consistent with an axonal polyneuropathy with a dominant motor component, suggestive of polyradiculopathy or distal motor polyneuropathy. These abnormalities have been previously described in motor polyneuropathies of undetermined origin (6,8,13). In our case, the proximo-distal repartition of the electromyographic abnormalities and the normal CSF could indicate a distal nerve disease. However, the tibial nerve F-ratio was within adult cat reference ranges, which should indicate an equal distribution of the neuropathy between the proximal and the distal parts of the nerve. To our knowledge, tibial nerve F-ratio reference ranges have not been established in young cats, and their accuracy in differentiating proximal, distal or equal distribution of neuropathy has not been assessed in cats. Albuminocytologic dissociation is commonly, but not always, observed in acute inflammatory polyneuropathy in humans (Guillain-Barré syndrome) (2,3,14,21), in acute idiopathic polyradiculoneuritis in dogs (2,3,22), and described once in a cat with idiopathic polyneuritis and polymyositis (19).

Idiopathic polyneuritis is a rarely diagnosed entity in cats, probably due to lack of advanced histopathological data. This case report focuses on the necessity for electrophysiology and advanced histopathology in feline neuromuscular disease investigation. Previous descriptions of documented inflammatory polyneuropathies have been associated with a poor prognosis or
responding to long-term corticosteroid therapies. This is the first histopathological description of acute self-limiting idiopathic immune-mediated feline polyneuropathy.

Acknowledgments
Thanks to Nicolas Blanchard-Gutton and Andrada Constantinescu from the UPR de Neurobiologie at the Ecole nationale vétérinaire d’Alfort for technical preparation of muscle biopsies, and to Diana Warwick for help with English.

References

Book Review
Compte rendu de livre

Small Animal Ophthalmic Atlas and Guide

This book is brilliant as a quick reference guide. In her preface, Dr. Lim states that “As a general practitioner…I wished for a reference where I could find a photograph similar to what I observed in a patient, along with enough information to implement a plan for treatment.” That is exactly what she has created.

It is very telling of Dr. Lim’s priorities that the glossary is at the front of the book. This is what we are discussing, and this is the language we will use. It is immediately followed by 55 pages of large color pictures organized into the differing anatomical regions that are often used to organize ophthalmology lectures. Each picture has a brief description and refers to the page numbers in the second section of the book that is also marked by color coordinating tabs. Section II includes a general description of the anatomic area followed by information for each disease. Included are a description of the disease process, predispositions, characteristics of the disease, treatment plan, prognosis, and practical tips. In some cases there are also references for further reading. All of these are in a concise, point-form format. Finally, an index at the back completes the organization of this book.

The strengths of this book are plentiful. It has practical, well-organized, concise information. The pictures are clear, the descriptions are useful, and, when necessary, pictures include helpful arrows for clarity. We suspect Dr. Lim is an excellent speaker, as her book reads like an ophthalmology lecture.

If we were to wish for any changes to this reference, they are minor. More pictures showing variations of the diseases would be lovely, but obviously would drive up the cost of this very reasonably priced book.

Within days of receiving this book, we began to use it in our practice. For the general practitioner looking for a practical ophthalmology reference, this book is well worth the purchase.

Reviewed by Barb Muzyka, DVM and Terri Pettifor, RSc, DVM, Ottewell Animal Clinic, 6142 90th Avenue, Edmonton, Alberta T6B 0P2.
Successful treatment of *Solanum dulcamara* intoxication in a Labrador retriever puppy

Megan Kees, Nicole Beckel, Claire Sharp

**Abstract** — A 10-week-old intact male Labrador retriever dog was presented for acute onset of weakness, ataxia, and generalized muscle tremors. The puppy was suffering respiratory and central nervous system (CNS) depression, was mildly pyrexic, and vomited plant material that was identified as creeping nightshade (*Solanum dulcamara*). He responded well to supportive care and was discharged successfully. To the authors’ knowledge, this is the first report of *Solanum dulcamara* toxicity occurring in a dog.

**Résumé** — Traitement réussi d’une intoxication par *Solanum dulcamara* chez un chiot Labrador retriever. Un chien Labrador retriever mâle intact âgé de 10 semaines a été présenté pour l’apparition aiguë de faiblesse, d’ataxie et des tremblements musculaires généralisés. Le chiot souffrait d’une dépression du système respiratoire et du système nerveux central (SNC), présentait une pyrexie légère et vomissait du matériau végétal qui a été identifié comme étant de la morelle douce-amère (*Solanum dulcamara*). Il a bien répondu à des soins de soutien et a reçu un congé pour un traitement réussi. À la connaissance des auteurs, c’est le premier rapport d’une toxicité de *Solanum dulcamara* se produisant chez un chien.

*Solanum dulcamara* is a nightshade plant known as bitter-sweet nightshade, creeping nightshade, or woody nightshade (1). It has dark green leaves, star-shaped purple flowers with backward pointing petals, and a large yellow stamen at the center (Figure 1) (2). The berries are ovoid and change from green to red as they ripen (Figure 1) (2). This plant is native to Europe, Asia, and northern Africa, it is naturalized in the United States, and is often considered an invasive weed species (2). About 1500 species of *Solanum* exist worldwide (1). *Solanum* spp. toxicosis has been reported in children, horses, and livestock, but published reports in small animals are lacking (4–10).

The toxic principle of *Solanum dulcamara* is the steroidal glycoalkaloid solanine (3). Following ingestion, solanine is poorly absorbed from the gastrointestinal (GI) tract causing local irritation and clinical signs of hypersalivation, vomiting, diarrhea, and ileus (1). In the GI tract, solanine is also hydrolyzed to solanidine, which is absorbed and produces the systemic toxidrome of neurologic, cardiovascular, and respiratory signs (1). Reported signs include mydriasis, central nervous system depression, muscle tremors, incoordination, tachycardia or bradycardia, and respiratory difficulty (1). Neurologic signs result from direct neurotoxic effects of solanidine in addition to acetylcholinesterase inhibition (3). Due to its similarities to cardiac glycosides, solanine and solanidine also have positive inotropic effects (8).

The amount of toxin present in various parts of the plant depends on the climate, soil, amount of light, and season, but in general, the unripe fruit and leaves are most toxic (1–3). Gastric and small intestinal epithelial necrosis was noted in Syrian hamsters fed unripe fruit from *Solanum dulcamara* and 8 of 10 died (11). There were no signs of toxicity or histologic changes in mice gavage fed ripe berries from early summer, while those fed unripe berries from early summer had histologic changes without toxicity and those fed unripe berries from later in the summer had signs of toxicity but few histologic changes, suggesting that toxicity of the berries can vary seasonally (12). Experimental studies have also shown a wide variety of tolerance to the amount of toxin delivered depending on the species of animal (8). For instance, oral doses of solanine at 3 mg/kg body weight (BW) produce clinical signs of dyspnea, drowsiness, and hyperesthesia in humans, 20 to 35 mg/kg BW is lethal in rats and rabbits, whereas oral doses of 225 mg/kg BW are not lethal in sheep (8).

The objective of this report is to describe the clinical course and successful treatment of confirmed *Solanum dulcamara* toxicity in a dog.
A 10-week-old intact male Labrador retriever puppy weighing 6 kg was presented to the emergency department of a private referral hospital in Massachusetts, USA in the spring with an acute onset of weakness, ataxia, and muscle tremors. He had been in a crate with his sibling for several hours prior to the referral hospital. The puppy had previously been healthy, and the sibling was not exhibiting any clinical signs. His vac-


table was current for a dog of his age.

On physical examination at the time of presentation, he was mentally obtunded and recumbent with generalized muscle tremors. He was pyrexic (rectal temperature: 39.7°C), tachycardic (heart rate: 160 beats/min), and tachypneic (respiratory rate: 50 breaths/min), with a short, shallow respiratory pattern. His cranial nerve responses were intact. An initial venous blood gas analysis revealed a mild hypercapnia at 47.9 mmHg [reference interval: 35 to 45 mmHg], with mild hyperglycemia and normal electrolyte concentrations (Table 1, T0). A complete blood (cell) count and full biochemistry panel revealed a mild anemia (Hct: 26.5%) and hypoproteinemia (total protein 38 g/L), consistent with the patient’s age. The patient vomited normal ingesta and plant material shortly thereafter so was given maropitant (Cerenia; Zoetis, Florham Park, New Jersey, USA), 0.5 mg/kg BW, IV and methocarbamol (Robaxin; West-Ward Pharmaceuticals), 4 mg/kg BW, IV. Anesthesia was maintained with a propofol CRI at 0.2 mg/kg BW/min, IV, a midazolam CRI at 1 mg/kg BW per hour, IV, and isoflurane gas at 1% in 100% oxygen at a flow rate of 1 L/min. The isoflurane was discontinued after 30 min, and anesthesia was maintained with propofol and midazolam. Oxygen was provided via flow-by through the endotracheal tube (ET). Gastric lavage was attempted, but the orogastric tube was too narrow to allow passage of material through it.

Case description

The owner subsequently found the plant in his backyard (Figure 2) where the puppy could have had access to it.

 measured parameter (reference interval)  
<table>
<thead>
<tr>
<th>Measured parameter</th>
<th>Time (hours) following initial venous blood gas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T0</td>
</tr>
<tr>
<td>PCO₂ (35 to 45 mmHg)</td>
<td>47.9</td>
</tr>
<tr>
<td>HCO₃ (18 to 25 mmol/L)</td>
<td>26.4</td>
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<tr>
<td>pH (7.35 to 7.45)</td>
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<tr>
<td>BE (~2 to 2)</td>
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<tr>
<td>Na (139 to 151 mmol/L)</td>
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<td>K (3.8 to 5.3 mmol/L)</td>
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<tr>
<td>Cl (102 to 120 mmol/L)</td>
<td>107.3</td>
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<tr>
<td>iCa (1.12 to 1.42 mmol/L)</td>
<td>1.33</td>
</tr>
<tr>
<td>Glucose (77 to 150 mg/dL)</td>
<td>167</td>
</tr>
</tbody>
</table>

PCO₂ — partial pressure of CO₂; BE — base excess.

Initial treatment included administration of flow-by oxygen, IV administration of Lactated Ringer’s Solution (25 mL/kg BW bolus followed by 5 mL/kg BW/h infusion), diazepam (Valium; Hospira, Lake Forest, Illinois, USA), 0.5 mg/kg BW, IV and methocarbamol (Robaxin; West-Ward Pharmaceuticals, Eatontown, New Jersey, USA), 55 mg/kg BW, IV. No improvement in tremors was noted, so midazolam (Hospira) as a continuous rate infusion (CRI) at 0.5 mg/kg BW per hour, IV, was started. The tremors subjectively worsened with this therapy, so it was discontinued after 15 min. A bolus dose of propofol (PropoFlo; Abbott, Abbott Park, Illinois, USA), 20 mg, IV was given, and the patient’s tremors ceased. A 60-mL (10 mL/kg BW, per rectum) warm water enema was administered to further decontaminate the gastrointestinal (GI) tract but did not result in a bowel movement.

Tremors resumed several minutes after the initial dose of propofol had been administered. The ASPCA Poison Control Center, Urbana, Illinois, USA, was consulted although the plant had not yet been identified. A tremorgenic toxin was suspected and, therefore, a higher dose of methocarbamol (100 mg/kg BW, IV) was recommended and administered. The tremors improved after this dose but were still present. Further consultation with the poison control center was sought, and phenobarbital (West-Ward Pharmaceuticals), 4 mg/kg BW, IV, was given as recommended. Tremors were lessened further with this; however, the patient became even more sedate. The dog’s temperature had normalized at this time (38.6°C) but the central nervous system (CNS) depression and vomiting caused concern for potential aspiration. We decided to intubate the puppy, so another dose of propofol, 2 mg/kg BW, IV, was given. Anesthesia was maintained with a propofol CRI at 0.2 mg/kg BW/min, IV, a midazolam CRI at 1 mg/kg BW per hour, IV, and isoflurane gas at 1% in 100% oxygen at a flow rate of 1 L/min. The isoflurane was discontinued after 30 min, and anesthesia was maintained with propofol and midazolam. Oxygen was provided via flow-by through the endotracheal tube (ET). Gastric lavage was attempted, but the orogastric tube was too narrow to allow passage of material through it.

Figure 1. Solanum dulcamara (A) flowers, (B) leaves and berries.

Table 1. Serial venous blood gas values in a Labrador retriever puppy following hospitalization for ingestion of Solanum dulcamara

Figure 2. Plant material from patient’s yard that was consistent with plant material that he vomited.
A multi-parameter unit (SurgiVet; Smiths Medical, Dublin, Ohio, USA) was used to facilitate continuous monitoring of the dog’s electrocardiogram (ECG), pulse oximetry (SPO₂), and oscillometric blood pressure. Ongoing IV fluid therapy was provided at 30 mL/h of isotonic crystalloid. The patient continued to breathe on his own and did not receive positive pressure ventilation; however, he did have mild episodes of hypotension which required adjustments in the rate of the propofol CRI and boluses of crystalloid and colloid. He also became hypothermic under anesthesia, so a forced air heating blanket was provided. Recheck blood gas analysis approximately 10 h after the initial database showed a more severe hypercapnia with respiratory acidosis, mild hypoplochremia, and mild ionized hypercalcemia (Table 1, T10). The patient was given intermittent positive pressure ventilation by hand to normalize the hypercapnia. Approximately 10 h after intubation the dog was weaned from anesthesia by gradual reductions in the rates of the propofol and midazolam CRIIs over the course of an hour. In preparation for extubation, the cuff of the endotracheal tube had been deflated, but the tube was still in place when the patient vomited clear phlegm. The tube was re-inflated and the oral cavity suctioned. There was a plug of mucopurulent phlegm at the end of the endotracheal tube when it was removed. The patient was temporarily re-intubated with a sterile endotracheal tube, and an endotracheal wash was performed for cytology and culture. Pulse oximetry was 94% on room air and end tidal CO₂ (ETCO₂) was between 37 and 40 mmHg at the time of extubation.

The puppy was recovered in 40% oxygen in an oxygen cage for several hours during which he experienced intermittent, non-productive coughing. He was alert enough to keep himself sternal at this time. Three view thoracic radiographs showed a diffuse, interstitial pulmonary infiltrate but no obvious dependent alveolar consolidations to indicate aspiration pneumonia (Figure 3). However, concerns for pneumonia remained due to the prior vomiting, so ampicillin with sulbactam (Unasyn; Auromedics, Dayton, New Jersey, USA), 50 mg/kg BW, IV, q8h, was started pending results of the endotracheal wash culture. The tracheal wash cytology showed neutrophilic inflammation, and the culture grew Escherichia coli that was susceptible to amoxicillin/clavulanate (Clavamox; Zoetis), both consistent with aspiration pneumonia. That afternoon, a CRI of metoclopramide (Reglan; Hospira) was also started, given reports of Solanum species causing gastrointestinal ileus. No additional doses of anti-emetics were needed. Oxygen therapy was discontinued 3 h after final extubation and the patient’s pulse oximetry was 96% on room air. Recheck venous blood gas the following morning showed resolution of the previously noted abnormalities (Table 1, T34).

After recovery from anesthesia, tremors did continue, but they were intermittent and minor compared to those on initial presentation. No additional medications were needed to control them. The patient’s mental status improved and he was ambulating normally 5 h after final extubation. The following morning, the puppy was bright and alert with normal mentation, and he began eating. Discharge, with complete resolution of clinical signs, occurred approximately 64 h after presentation to the hospital.

Discussion
To the authors’ knowledge, this is the first report of Solanum dulcamara toxicity in a dog. The clinical signs of GI upset, respiratory depression, and CNS depression in the puppy reported here are similar to those reported in other species with Solanum spp. toxicity, including horses, cattle, and children (4–9). These include reports of fatalities in humans and livestock from ingesting Solanum species. In 1 report, 6 horses received poor quality hay containing silverleaf nightshade (Solanum ecleignifolium) and white horse nettle (Solanum dimiditum); they had signs similar to those herein, including obtundation, ataxia, pyrexia, muscle fasciculations, and ileus (4). Other signs noted in these horses included urinary retention and cranial nerve deficits; however, these may have been due to concurrent ivermectin toxicosis (4). Therapy in these horses was not well described, but all 6 affected horses recovered (4). The literature also includes cases of Solanum dulcamara toxicosis in humans that were fatal (10) and cases that were successfully treated (6). One report documents the case of a child ingesting Solanum dulcamara who presented in an anticholinergic crisis with pyrexia, tachycardia, obtundation, and muscle tremors (6). She was treated with the cholinesterase inhibitors neostigmine and edrophonium with resolution of her symptoms.
inhibitor physostigmine and was discharged 36 h later (6). Other reports document *Solanum tuberosum* (potato) toxicosis, associated with high light exposure and increased concentrations of solanine in the plant (8).

Treatment in all reported cases of *Solanum* toxicity has been symptomatic and supportive. In our case, this supportive care consisted of IV fluid therapy, nausea control, prokinetics, and anesthesia to keep the patient intubated to protect the airway. Despite this, the patient did develop aspiration pneumonia. One could consider extubating patients with a partially inflated cuff to try to prevent this from happening in future cases. Also, we could have started the metoclopramide CRI sooner to try and prevent continued GI signs. Given its effectiveness in treating an affected child (6), the cholinesterase inhibitor physostigmine should be considered in future cases of suspected or confirmed toxicosis. The use of methocarbamol was not reported in other cases in the literature and the tremors herein seemed only minimally responsive even at higher doses. The mechanism of action of methocarbamol is not understood, but it does not appear to act on the muscle cells or motor end plates directly so a centrally acting depressant effect is thought to be the main mechanism of action (7). It is possible that the tremors would be responsive to even higher doses than those used in this study, or to a CRI, but it is also possible that methocarbamol is not effective against the tremorgenic effects of solanidine. Other toxins that cause tremors and need to be considered include bromethalin, metaldehyde, mycotoxins, methylxanthines, strychnine, organophosphates, amphetamines, selective serotonin reuptake inhibitors (SSRIs), and albuterol.

Intermittent ETCO₂ values were obtained in this patient. Continuous ETCO₂ monitoring would have been ideal for comparison to blood gas values and to monitor for hyperventilation and the need for positive pressure ventilation. However, when the patient was noted to have an elevated partial pressure of carbon dioxide (PCO₂), he was treated with manual hand ventilation. An ETCO₂ that was checked prior to extubation was normal. Intermittent manual positive pressure ventilation was enough to correct this patient's hypercapnia, but mechanical ventilation could have been considered in light of his obtunded mentation and poor ventilation.

This report describes the first known case and successful treatment of *Solanum* toxicity in a small animal patient. *Solanum* toxicity should be considered as a possible differential in patients presenting with compatible clinical signs where the plant is known to grow, especially in patients with generalized muscle tremors.

**Acknowledgment**

The authors thank The New England Wildflower Society for their assistance in identifying the *Solanum dulcamara* plant.

**References**


**Case Report**

**Bilateral renal T-cell lymphoma with hepatic infiltration and secondary polycythemia in a dog: Utility of cytology slides**

Rémi Froment, Carolyn Gara-Boivin

**Abstract** — This is a case of bilateral renal T-cell lymphoma associated with secondary erythrocytosis in a dog. This case is distinctive in using clonality combined with immunocytochemistry to support the diagnosis, thus emphasizing the utility of cytology slides when histology is unavailable. This combination may be a unique canine lymphoma entity.

**Case description**

A 8-year-old neutered male cross-bred Bernese mountain dog was presented to the emergency service of the Centre Hospitalier Universitaire Vétérinaire (CHUV) with a 2-week history of inappetence. Owners reported that the dog had chronic gastrointestinal signs. Nine days prior to presentation, a severe episode of profuse diarrhea had been symptomatically treated without major improvement. Upon presentation the dog was weak, bright, alert, responsive, and moderately dehydrated (6% to 7%). Abdominal examination caused discomfort and bilateral nephromegaly was suspected. The rest of the physical examination, including vital signs of the cardiopulmonary system (auscultation, heart and respiratory rates, mucous membrane color, femoral pulse) was unremarkable. The cardiopulmonary parameters remained unremarkable throughout the hospitalization. Initial diagnostic tests included blood work, complete urinalysis, and abdominal ultrasound followed by fine-needle aspirates of the kidneys, renal lymph nodes, and liver.

Routine hematology (Advia 120; Siemens Healthcare Diagnostics, Toronto, Ontario) revealed a moderate erythrocytosis [hematocrit (HCT): 0.65 L/L; reference interval (RI): 0.37 to 0.57 L/L; hemoglobin (HGB): 234 g/L; RI: 129 to 184 g/L; red blood cells (RBC): 9.6 × 10¹²/L; RI: 5.7 to 8.8 × 10¹²/L]. Considering the observed dehydration, erythrocytosis was initially thought to be secondary to hemoconcentration. A mild leukocytosis [white blood cells (WBC): 14.97 × 10⁹/L; RI: 5.20 to 13.90 × 10⁹/L] composed of a mature mild neutrophilia (12.43 × 10⁹/L; RI: 3.9 to 8.0 × 10⁹/L) without toxic changes was attributed to a physiologic response, although an inflammatory process could not be ruled out.

A serum biochemistry profile (Synchron DXC 600; Beckman Coulter, Fullerton, California, USA) revealed a moderate azotemia [blood urea nitrogen (BUN): 11.33 mmol/L; RI: 2.09 to 7.91 mmol/L and creatinine 194 μmol/L; RI: 58 to 127 μmol/L] of renal origin because of concomitant isoethsotrinuria (urine specific gravity, 1.012). Prerenal azotemia due to decreased glomerular filtration rate secondary to dehydration may also have partially contributed to the azotemia. Hypoproteinemia (52.30 g/L; RI: 56.6 to 74.8 g/L) was moderate considering the patient’s dehydration and was composed of a moderate hypoalbuminemia (25.80 g/L; RI: 29.10 to 39.70 g/L), probably secondary to a renal loss as a marked proteinuria was present (5 g/L, Chemstrip®). This reagent strip reading was likely accurate and unaffected by either the pH (pH = 5.5) or the specific gravity (1.012), which are reported to falsely increase the protein value when the urine is concentrated and highly or moderately alkaline. A mild hyperphosphatemia was noted (2.63 mmol/L; RI: 0.75 to 1.70 mmol/L), most likely due to decreased renal excretion. Hepatic changes included a mild increase in alanine aminotransferase (ALT) activity (125 U/L; RI: 4 to 62 U/L) and a marginal increase in alkaline phosphatase (ALP) activity (157 U/L; RI: 6 to 80 U/L). Moderate hyperbilirubinemia (20.80 μmol/L; RI: 0 to 8.6 μmol/L) along with slightly icteric serum and bilirubinuria (1+, Chemstrip®) indicated that a mild icterus was present, most likely of hepatic origin as there was no evidence of
Together, these changes indicated mild hepatocellular damage and cholestasis. Electrolyte abnormalities consisted of a mild hypernatremia (158.3 mmol/L; RI: 143 to 154 mmol/L) and hyperchloremia (125.2 mmol/L; RI: 108 to 117 mmol/L), most likely secondary to pure water loss. Mild hypocalcemia (2.31 mmol/L; RI: 2.38 to 3.00 mmol/L) was attributed to hypoalbuminemia.

The urinary sediment revealed a few large phagocytic cells (Figure 1A) and rare small lymphocytes. Large cells contained variable amounts of hematoidin crystals but no obvious signs of erythrophagocytosis. Taking into account the predisposition of Bernese mountain dogs to histiocytic sarcoma (HS) along with the urinary sediment findings, an HS with renal/urinary involvement was included in the differential.

Ultrasound examination by a board-certified radiologist confirmed a moderate bilateral nephromegaly (Figure 2) and showed a loss of cortico-medullary distinction with pelvic dilation. Other changes detected by ultrasound consisted of a slight hepatomegaly with multiple hyperechoic nodules, moderate splenomegaly with no evidence of parenchymal changes and enlargement of the renal lymph nodes. Fine-needle aspirates of both kidneys, liver, and renal lymph nodes were obtained. Renal cytology smears were highly hemodiluted with overall adequate cellularity. The major population was composed of intermediate round cells with a high nucleus to cytoplasm ratio (Figure 1B). The cytoplasm was scant to moderate, pale basophilic and mostly localized on one side of the cell. A rounded to irregular indented nucleus was observed, containing an open to sometimes stippled chromatin associated with 1 or 2 discrete nucleoli. A few renal epithelial clusters mostly of tubular origin were present (Figure 1B). Low numbers of macrophages were observed. A moderate quantity of cytoplasmic fragments were scattered throughout the smear. Morphological appearance of the malignant population was diagnostic of a bilateral renal malignant round cell tumor that was most consistent with lymphoma. Cytology smears of the renal lymph nodes were highly hemodiluted with mainly ruptured cells. A final diagnosis could not be made although lymphoma was considered based on the
Numerous intermediate lymphocytes (Figure 1C). Liver cytology smears were composed of a few normal hepatocyte clusters on a highly hemodiluted background. Occasional intermediate lymphocytes were observed and lymphoma was suspected; however, a contribution of lymphocytes from the hemodiluted background could not be ruled out.

Over the 72-hour hospitalization time, manual measurements of the hematocrit revealed a persistent erythrocytosis (values ranging between 0.57 and 0.65 L/L; upper reference limit: 0.57 L/L) despite fluid therapy composed of 2 to 3 times daily maintenance requirements [Plasmalyte A (Baxter, Mississauga, Ontario) supplemented with KCl]. Combined with the lack of evidence of cardiopulmonary abnormalities and diagnosis of renal neoplasia, inappropriate erythrocytosis was suspected. Measurement of erythropoietin (EPO) levels in the patient’s serum sample performed by radioimmunoassay (RIA) in a reference laboratory (NationWide Specialist Laboratories., Pampisford, Cambridge, UK) showed a moderately increased EPO (42 MU/mL; RI: 8.4 to 28 MU/mL). Further characterization of the neoplastic population was performed in a referral laboratory (Leukocytes Antigen Biology Laboratory, UC-Davis, Davis, California, USA). Immunostaining for CD3 yielded a positive reaction for CD3 in more than 75% of the cells on both kidney aspirates (Figure 1D), supporting a T-cell origin. Positive clonal gene rearrangements for T-cell receptor (TCR)gamma also indicated a T-cell origin. Clonality assay on the renal, liver, and nodal cytology smears revealed a similar positive TCRgamma rearrangement, supporting neoplastic involvement by a clonal T-cell population. A diagnosis of bilateral renal T-cell lymphoma with hepatic infiltration and secondary polycythemia was thus based on clinical findings, clinical pathology, imaging, clonality, and immunocytochemistry. The owners opted for euthanasia and declined necropsy.

**Discussion**

Erythrocytosis is defined by an elevation of the erythrocyte count in the peripheral blood and is detected by an increase in the HCT, RBC count, or hemoglobin concentration. The first dichotomy for erythrocytosis involves the distinction between a relative process and an absolute elevation of the aforementioned erythroid parameters. The cause of a relative erythrocytosis is either hemoconcentration or a transient physiologic erythrocytosis (splenic contraction). In our reported case, the dog was moderately dehydrated when the blood was sampled and a relative erythrocytosis secondary to hemoconcentration was the initial diagnosis. Moderate dehydration was attributed to intestinal water loss from diarrhea and probable renal water loss. Renal disease was supported by moderate azotemia and isosthenuria. Although routinely recommended to further support relative erythrocytosis, assessment of the total protein concentration could not support hemoconcentration as obvious protein loss with marked proteinuria was present. Follow-up complete blood counts (CBCs) after normalization of hydration status is a way of confirming the relative nature of erythrocytosis. In our case, the dog’s hematocrit remained elevated during hospitalization despite appropriate fluid therapy, supporting a cause other than hemoconcentration or splenic contraction for erythrocytosis.

Once relative erythrocytosis is ruled out or made less likely, absolute erythrocytosis can be further characterized as primary or secondary. A primary absolute erythrocytosis is an autonomous and neoplastic production of the erythroid cells such as in polycythemia vera. Although bone marrow was not examined in this case, this condition was very unlikely. The term “secondary” indicates erythroid production in response to EPO stimulus as opposed to autonomous erythroid production found in polycythemia vera. Secondary absolute erythrocytosis can also be further described: it is “appropriate” when there is sustained hypoxia, documented with a PaO2 on a blood gas while it is “inappropriate” if the EPO production is autonomous and independent of systemic hypoxia. The etiology for such process includes benign and malignant conditions with both involving either production of EPO or an EPO-like substance.

Shortly after documentation of the erythrocytosis in this case, a bilateral renal round-cell tumor was diagnosed on cytology. Canine renal tumors including carcinomas, sarcomas, and lymphomas have been associated with secondary absolute inappropriate erythrocytosis. Canine EPO measurement has been investigated by use of RIAs based on cross-reactivity of antibodies against human EPO, generating method-specific and laboratory-specific reference ranges. Here, the moderate elevation of EPO indicated a secondary absolute erythrocytosis. Human secondary erythrocytosis always displays increased EPO levels (1); however, in dogs normal to increased values can be expected (2) since there is a range overlap. It is highly likely that the reported absolute erythrocytosis was inappropriate due to a normal cardiovascular examination that didn’t support systemic hypoxia, although PaO2 measurement would have been ideal to draw definitive conclusions. Unfortunately arterial blood gas measurement was not performed at any time. Histopathology and immunohistochemistry could have helped to determine if EPO was produced by neoplastic lymphocytes by assessing the pattern of EPO activity between normal remnant renal cells and neoplastic cells.

Over a 30-year period, 15 cases of canine renal lymphoma have been described (3–11). The present case is the 6th case of combined renal lymphoma and secondary erythrocytosis to...
have been reported in dogs (4–6,10). To the best of our knowledge, there is only a single recent case report of human renal lymphoma with EPO expressing neoplastic cells and secondary paraneoplastic erythrocytosis (12). This suggests that although rare, the association of erythrocytosis and renal lymphoma might be a more common lymphoproliferative entity in dogs than in humans. There have been 6 reports of human lymphoid tumors with concomitant non-primary absolute erythrocytosis, including a solid lymphoma in the lungs (13), 4 cases of lymphoid leukemias (14,15), and only 1 recent renal lymphoma case (12). This rare association is therefore not usually mentioned in the diagnostic approach to human erythrocytosis (2).

Of interest is the exclusive T-cell phenotype that has been identified in canine renal lymphoma, particularly when secondary erythrocytosis is present. To our knowledge, no primary canine renal B-cell lymphoma has been reported when immunohistochemistry was performed. By fully documenting a 4th confirmed T-cell lymphoma with secondary erythrocytosis in dogs, we provide further evidence that this association is not isolated and that it may rely on a particular underlying pathological pathway of T-lymphocytes. In veterinary medicine, paraneoplastic EPO production seems to be the main stimulus for erythrocytosis in cases of lymphoma. This is supported by elevated plasma EPO (4,5,15), evidence of active EPO transcription (16) and cytoplasmic EPO expression by the neoplastic lymphocyte population (5,16). Further research with systematic phenotyping of canine renal lymphoma, EPO measurement and identification of EPO activity in neoplastic T-cells is warranted.

Lymphoma is a common canine neoplasm with an updated classification (17) based on the human World Health Organization classification of tumors of hematopoietic and lymphoid tissues. It is based on the recognition of entities that meet unique morphological, immunophenotypical, genetic, molecular, and clinical criteria in order to facilitate diagnosis and provide practical data for the oncologist. Some entities are not fully understood, thus justifying provisional groups, such as the heterogeneous Peripheral T-Cell Lymphoma Not Otherwise Specified (PTCL-NOS). Updates or clarifications are regularly proposed following new discoveries including better understanding of the normal T-cell counterpart (18). Canine T-cell lymphomas represent only up to a third of all canine lymphomas (17) including the heterogeneous PTCL-NOS group and other subtypes. Recent studies, including molecular profiling (19) and subtyping of T-Cell lymphoma (20) will likely help establish subgroups or entities with prognostic significance. In the case of renal lymphoma, the first matter would be to determine if it is of primary renal origin as opposed to a secondary site. In this reported case, the main clinical signs were associated with renal disease; however, there was extrarenal lymphomatous involvement. It is unknown if the neoplasm disseminated rapidly from a primary renal origin, or if renal involvement was an extension from an adjacent site. Unfortunately further description and classification of our case was not possible since clear evidence of the origin, complete grading of the tumor and histopathology were lacking. In the future, systematic characterization of renal lymphoma, including clinical data, histopathology, immunophenotyping and subtyping as well as molecular profiling could be rewarding in determining if renal T-cell lymphoma can be considered a unique entity in dogs.

In dogs, cytology is a sensitive and specific diagnostic test for lymphoma. In our case, the breed predisposition to HS, the occasional irregular indented nuclei among renal atypical round cells and the presence of large phagocytic atypical cells in the urine raised suspicion for HS, although lymphoma remained the primary rule out. Equivocal cases can benefit from a polymerase chain reaction (PCR) clonality assay to support the presence of a clonal lymphoid population (21) as in the present case. Sensitivity for TCRgamma rearrangement has recently been reported to be 100% (22) while specificity is > 95% (23). The number of neoplastic cells or their intact DNA content required for the test is low (21), thus making cytology specimens including stained slides a convenient choice. This is especially relevant for critically ill patients. Confirmation of a clonal lymphoid expansion can be quickly obtained without further invasive procedures such as surgery and biopsies. Immunocytochemistry is often recommended to confirm the lineage of neoplastic cells in lymphoma and leukemia. In this particular case, CD3 was strongly positive, further supporting the T-cell origin. Nonetheless, histology and immunophenotyping remain essential for a more precise diagnosis by providing architecture assessment and subtyping.

In conclusion, we report a 6th canine case of combined renal lymphoma and secondary erythrocytosis. The diagnosis was based on clinical findings, clinical pathology, imaging, clonality, and immunocytochemistry. To our knowledge this case is unique in its use of cytology smears to confirm a diagnosis using clonal proliferation of T-lymphocytes with the TCRgamma rearrangement clonality assay and immunocytochemistry, thus emphasizing the utility of cytology slides when histology is unavailable. Renal lymphoma of T-cell lineage with secondary erythrocytosis may constitute a unique canine entity among the heterogeneous PTCL-NOS lymphoma group. Further systematic study is recommended to investigate this hypothesis when such cases present.

Acknowledgments
The authors thank Kristy Harmon and Dr. Peter Moore from the Leukocytes Antigen Biology Laboratory at the University of California-Davis for their performance of clonality assays and immunocytochemistry.

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Commentary  Commentaire

Taking care of our professional responsibility to prescribe — for ourselves, our children, and our community

Kelly M. Butler OVC 1986

Recent Sunday morning conversations about antimicrobial resistance (AMR) on CBC reveal that the use of antibiotics on pets is still flying under the public radar. This oversight does not absolve clinicians of our responsibility.

How do we veterinarians contribute to the looming menace of what will become ineffective antibiotics moving our Canadian population from about 7% of deaths due to infection to greater than 50% as estimated by the Chief Medical Officer of England? This would be a step back into the Middle Ages. Well, those nations in which antibiotics are available on street corners — India, China, and the continent of Africa will get there first — we will have a preview. Of course many of those antibiotics are counterfeit, but that is a separate discussion.

First of all, it might be helpful to admit that we veterinarians are in a clear position of conflict every time we script an antibiotic for a large dog, perhaps $30 or $40 goes into our pockets apart from the prescription fee. This is not the case with physicians.

Well, really what harm do antibiotics for pets do? Cefovecin or amoxicillin/clavulanic acid for 2 weeks in a cat for an abscess? Doxycycline for 4 weeks for a dog that has a high Borrelia burgdorferi titer (with no clinical signs)? “Prophylactic” antibiotics for a week for a young healthy dog with a cut on his paw? Oral antibiotics for every hot spot (not pyoderma)? Post spay/neuter injections of “Duplo”? As a locum I have observed many practices following several of these protocols but especially the latter which has perhaps been carried over from the first veterinarian for whom the owner/clinician worked. Not a bad idea maybe simply years of cohabitation. Our patients routinely share their microbes directly with their humans whether by kisses or simply years of cohabitation. Our patients share their microbes directly with their owners and locum; former avid consumer of antibiotics necessitated by chemo and radiation therapy.

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Formerly on staff as a virologist/field epidemiologist with the WHO in the Western Pacific; previously and currently a practice owner and locum; former avid consumer of antibiotics necessitated by chemo and radiation therapy.

The Infectious Diseases Society of America recently (2014) updated clinical practice guidelines related to management of skin and soft tissue infections, no doubt in no small part to get ahead of the challenges of antibiotic resistant pathogens and the increasing number of immunocompromised patients requiring antibiotic treatment for a spectrum of ailments. Incision and drainage only is appropriate treatment for abscesses in the absence of clinical illness: fever, tachycardia, or tachypnea. But of course, the clinician is entitled to their clinical judgment.

When we veterinarians make that call, we might consider that the list of antimicrobial resistant organisms is longer than generally known, involving virtually all common skin and gut organisms (http://www.cdc.gov/drugresistance/biggest_threats.html)

Where does our clinical judgment come in? There are as many considerations in veterinary medicine as in human medicine, but there are a few common uses: feline lower urinary tract disease (FLUTD) cats have essentially no bacteriuria according to sound veterinary research. Maybe we are not “charging” for the long acting penicillin injection but what exactly is that “insurance” on aseptically performed surgery doing? Abscesses are mentioned above, as is the response to elevated Borrelia burgdorferi antibodies in some practices.

Scott Weese DVM, DVSc, DipACVIM, gently encouraged us in a recent continuing education (CE) lecture to not keep looking for the bacteria post urinary tract infection (UTI), rather if there are clinical signs then treat. He also recommends and refers to the science for shorter treatment courses when antibiotics are required. Too much information (TMI) as my children say, but last month, the course of antibiotics scripted for me for a UTI was for 5 days. So far so good. The science is shifting in veterinary dentistry from providing antibiotics for dental procedures, where they should be the exception rather than the rule.

Typically in our profession, there is not enough research conducted directly on pets but we know that the species we deal with are in close proximity to their owners. They share their microbes directly with their humans whether by kisses or simply years of cohabitation. Our patients routinely share their bacteria/viruses with acquaintances in the dog park or along alley fences and so they also share their little packets of antimicrobial resistance with each other and their humans. Imagine all the sharing with the owner who has kept 3 or 4 pets at a time over a 70-year life span — that’s about the length of time we have had antibiotics in our toolkit.

Each time we decide to prescribe antibiotics we might well consider the implications not only for our patients, which will be significant, but also for ourselves, our children, and our community in the long-term.
1. **C)** PDA is associated with a continuous left basilar murmur and bounding femoral arterial pulses. The remaining congenital defects are associated with systolic murmurs.

**C)** La persistance du canal artériel est associée au souffle basilaire gauche continu et aux pouls fémoraux artériels bondissants. Les autres défauts congénitaux énumérés sont associés aux souffles systoliques.

2. **D)** Answers A and C are not seasonal and are usually intensely pruritic. E also is not seasonal and is not a pruritic disease unless secondary infections are present.

**D)** Les réponses A et C ne sont pas des affections saisonnières et elles sont habituellement des prurits intenses. La réponse E n’est pas non plus saisonnière et ce n’est pas une maladie prurigineuse à moins que des infections secondaires soient présentes.

3. **D)** This is the classic description of a corneal sequestrum. A melting ulcer, eosinophilic keratitis, or descemetocoele would not be brown in color.

**D)** Il s’agit de la description classique du séquestre de la cornée. Un ulcère fondant, la kératite éosinophile ou le desmétocèle ne sont pas de coloration brune.

4. **C)** Prednisone would be contraindicated in a case of endotoxemia because of its immunosuppressive potential. Aspirin and meloxicam are not approved for use in horses. Flunixin improves hemodynamics in endotoxemic shock, an advantage that phenylbutazone does not present.

**C)** La prednisone serait contre-indiquée dans un cas d’endotoxémie à cause de son potentiel immunosupresseur. L’aspirine et le méloxicam ne sont pas homologués pour usage chez les chevaux. La flunixinne améliore l’hémodynamique dans le choc endotoxémique, un avantage que ne possède pas la phénylbutazone.

5. **B)** Rigor mortis is contraction of striated muscle after death. Smooth muscle is not affected (Choice E is incorrect). The process begins within hours of death of the animal, but is not a permanent condition, as tissue autolysis or decomposition will affect rigor (Choice A is incorrect). Rigor mortis begins in the myocardium, and then progresses to affect muscles of the head, neck, and limbs (Choice B is correct). High body temperature actually accelerates the process of rigor mortis, so Choice C is incorrect. Rigor mortis does not affect the color of the tissues (autolysis does), so Choice D is incorrect.

**B)** La rigidité cadavérique est la contraction des muscles striés après la mort. Les muscles lisses ne sont pas affectés (le choix E est incorrect). Le processus de rigidité débute dans les heures qui suivent la mort de l’animal, mais ce n’est pas un état permanent, puisque l’autolyse ou la décomposition des tissus affectera la rigidité (le choix A est incorrect). La rigidité cadavérique débute dans le myocarde, puis progresse pour affecter les muscles de la tête, du cou et des membres (le choix B est correct). Une température corporelle élevée accélère le processus de rigidité cadavérique, ainsi le choix C est incorrect. La rigidité cadavérique n’affecte pas la couleur des tissus (l’autolyse l’affecte), de sorte que le choix D est incorrect.
The Art of Private Veterinary Practice
L’art de la pratique vétérinaire privée

Stress and communication

Myrna Milani

When a reporter writing a feature article for the local paper asks the veterinarians at the Downton Veterinary Hospital what contributes the most to their on-the-job stress, they give the same answers they give to their casual friends. Dr. Stegemier mentions how stressful coping with the challenges that often arise when dealing with critically ill patients can be.

“When animals are critically ill even the most routine diagnostic procedures can be problematic,” she explains. “For example, some of these animals may not be able to withstand anything beyond the most minimal handling. At the same time, they may be poor anesthesia risks or the nature of their problems may limit the kinds of drugs we can use safely. Older animals in particular may have more than one problem and the best treatment for one may be ruled out by limitations associated with the other. Until you get the animal stabilized, things can change in an instant.”

When asked this same question Dr. Stegemier’s colleague, Dr. Phelong, notes that he finds performing euthanasia highly stressful.

“I accept that sometimes this is the best and even only humane option,” he readily admits. “But I define myself as a healer and I can’t help feeling that I’ve somehow failed the animal as well as the clients when this happens. It stresses me just thinking about it.”

Later when the reporter interviews Dr. Broule, the practice owner, over lunch, the veterinarian mentions another source of stress that does not surprise the interviewer any more than it would surprise other practitioners or most of the public: dealing with fractious animals.

“I don’t know what’s worse — the animal I’ve never met who turns out to be aggressive or out of control, or the known patient with chronic behavioral problems whose owner ignores my recommendations regarding what to do about it,” she tells the other woman as they wait for their meals. “Those animals can make even the simplest procedures so grueling that I can stress out just thinking about them!”

Although these stressors are familiar to most practitioners, would these 3 veterinarians give the same answers in more confidential settings? The results of a recent survey suggests that they may not. In 2015 dvm360, Veterinary Economics, and Firstline magazines repeated a Job Satisfaction Survey originally done in 2005. Comparison of the findings of the current survey of more than 900 male and female associates and practice owners to those of the 500 respondents in the 2005 one is thought-provoking (1).

Of particular interest to the Downton Veterinary Hospital practitioners following their interviews with the local media were the responses to the question, “Which of these contributes most to your on-the-job stress?” The list included the stressors they had mentioned as well as the following: difficult boss, difficult coworkers/staff, difficult clients, time management issues, clients’ inability to pay, and “other.” What caught their attention was that, although the 3 stressors they mentioned were represented, they were only 8% of the total mentioned by respondents. Additionally all of the other stressors mentioned

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but one — difficult boss — were more strongly represented than these 3 stressors combined (Figure 1).

Although all three of the veterinarians read the article, none of them mentioned it to the other two. However the discrepancy between the prevalence of the top stressors they mentioned for public consumption and the others included in the survey did not escape their notice. During the following weekend though, all of them mentioned the survey results to others. And regardless whether they discussed the subject with a trusted partner, relative, or best friend, they all received the same kind of feedback.

When Drs. Stegemier and Phelong showed the graph to their respective confidants, neither of those individuals was surprised by the findings. Both noted that while the exact percentages of the other stressors may not be identical, their work-related conversations with the veterinarians were far more likely to include the practitioners venting about problems with co-workers, other staff members, their employer, or other issues unrelated to their one-on-one interactions with animals.

“You still get upset about those obnoxious clients and those who didn’t pay their bills years ago!” Dr. Stegemier’s long-time best friend reminded her. “And it seems like you’re always irritated by something that one of the staff members or your boss did.”

“I know it upsets when you have to euthanize an animal,” agrees Dr. Phelong’s partner. “But that doesn’t happen every day like some of the other stressors on the graph. You’re always complaining about not having enough time or something one of the other vets or staff members or clients did.”

Dr. Boule’s husband reminds her that while fractious or critically ill patients or euthanasia did possess the potential to upset her, more often than not these were offset by more rewarding patient interactions. On the other hand the time and business management issues, the people issues were chronic concerns of hers.

“The stressors you and the other vets mentioned to the reporter are those the media and public expect to stress you the most because they’re directly related to animals,” he points out. “They don’t want to hear or read that you experience the same kind of work-related communications problems that stress them too.”

As Dr. Boule considers the role public expectations might have, she realizes that there is some truth in what her husband said. She did believe that the answers she and her associates gave were the expected ones. Once she admitted this, she also realized how this had undermined her willingness to address the other stressors that were affecting her and members of her staff.

As she explained to her associates later, “Once I defined those animal-related stressors as the most important ones, the others were automatically demoted. Or I thought they were. According to my husband, they still bothered me but I stressed out and complained about them to him instead of doing anything to resolve them.”

When Drs. Stegemier and Phelong indicated that they were doing the same thing, the practice owner set aside time to address all of the stressors in more detail. At the meeting, they began with a discussion of the stresses associated with critically ill or fractious patients and euthanasia. Although they always had agreed that these were stressful events, this time Dr. Brule mentioned coping strategies that she had found helpful over the years and encouraged her associates to share theirs. In addition to sharing and gaining insights about these topics, they also established a format for addressing the other ones by the end of this discussion.

Next Dr. Brule focused the discussion on the two client-related stressors as she and they perceived them. Relative to non-paying clients, the practice owner discovered that her associates often felt personally responsible for this even though they had followed the practice policy of discussing costs beforecommencing treatment. Dr. Brule assured them there was no reason for them to feel that way when this was the case. Furthermore she apologized if her personal concern about these had caused them to feel that way. For their part, the associates admitted that there were times when discussing payment options was difficult for them. This led the practitioners to share old and develop new strategies to help them diminish this stress.

It did not take long for the practitioners to realize that the stresses associated with difficult clients and co-workers were quite similar. Although individual scenarios varied greatly and they spent more time with coworkers, the fundamental challenge remained the same: how to have meaningful communication with someone they found troublesome for some reason at that particular time. By discussing this in an abstract way, they were able to see that the biggest problem was a reluctance to address the issues that bothered them when they occurred. Not only did this increase the probability that the problem would persist or recur, it practically guaranteed the stress associated with it would increase too.

To give this awareness more relevance, Dr. Broule had her associates role-play various stressful scenarios that involved clients and staff. By trading roles and keeping the tone light and nonjudgmental, the veterinarians progressed from mild stressors to major ones. The more they engaged in the roles, the more they understood their own as well as others’ responses in certain situations. Dr. Broule also asked them to repeat the exercise with the boss as the stressor with them assuming her role while she assumed theirs or that of clients or other staff members. At the end of each scenario, they shared their observations and the strategies they found the most helpful to address the stressor if possible, or minimize its effect if not. They also decided that the entire staff would benefit from a similar activity.

Using these approaches, Dr. Broule and her staff learned to appreciate the critical role quality communication plays in preventing or minimizing stress in a busy veterinary practice.

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