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Let’s answer the “Why?”
Une réponse au «Pourquoi?»

Veterinarians are often asked why? Why is there a need for better stewardship regarding antibiotic use? Why are we spending a lot of resources and effort in increasing the oversight of antimicrobial use in animals? The threat of antimicrobial resistance (AMR) is obviously driving this, but we are also not the only profession utilizing antibiotics. Why do we need increased oversight of prescribing and dispensing? Why do we need to show that we are using antimicrobials appropriately in animals? International and national pressure, as well as public perception are all determining factors.

If compared, the issue of antimicrobial resistance in veterinary medicine versus human medicine, the veterinary field has relatively fewer issues. While AMR is already a huge issue in human medicine, it is of increasing concern in veterinary medicine. However, both fields of medicine use the same important antibiotics and there exists a risk of misuse creating resistance. The biggest issue for veterinary medicine is that 70% to 75% of all antibiotics given to animals is through livestock feed without veterinary oversight. There is much emphasis on food animals and the use of antimicrobials in feed; however, use in companion animal practice where pets are in close contact with their owners is also important. Small animal practitioners are more likely to prescribe Class 1 and 2 antibiotics, which are the most important to human medicine. Veterinarians need to be accountable in all areas of veterinary practice.

The Pan Canadian Framework document on veterinary oversight of antimicrobials, published by the CVMA last year addressed what the Association felt oversight of prescribing and dispensing of antimicrobials should look like. The document did not, however, address the important issue of surveillance. Surveillance means more than the surveillance of resistant bacteria; it includes the collection of data on the use of antimicrobials. With funding from the Canadian Food Inspection Agency, the CVMA is working on ways of gathering information on antimicrobial use in large and small animal practices.

The Association held a workshop in late February with approximately 50 stakeholders. The workshop looked at how antimicrobial use in large and small animal practices.

On demande souvent pourquoi aux médecins vétérinaires. Pourquoi avons-nous besoin d’une meilleure antibiogouvernance? Pourquoi consacrons-nous de vastes ressources et investissons-nous des efforts importants pour accroître la surveillance de l’utilisation des antimicrobiens chez les animaux? La menace de l’antibiorésistance représente évidemment le moteur de cette initiative, mais nous ne sommes pas non plus la seule profession qui utilise des antibiotiques. Pourquoi avons-nous besoin d’une supervision accrue de la prescription et de la distribution des médicaments? Pourquoi devons-nous montrer que nous utilisons les antimicrobiens de manière adéquate chez les animaux? La pression internationale et nationale ainsi que la pression et les perceptions du public représentent tous des facteurs déterminants.

En comparant la médecine vétérinaire et la médecine humaine, nous constatons que le domaine de la médecine vétérinaire présente relativement moins de problèmes. Cependant, même si l’antibiorésistance représente déjà un enjeu énorme dans les hôpitaux humains, elle suscite des préoccupations grandissantes en médecine vétérinaire. En effet, les deux domaines de la médecine ont recours aux mêmes antibiotiques importants et il existe un risque de mauvaise utilisation créant de la résistance. L’enjeu le plus important en médecine vétérinaire est que de 70 % à 75 % de tous les antibiotiques sont administrés aux animaux dans les aliments sans surveillance vétérinaire. On a beaucoup insisté sur les animaux destinés à l’alimentation et l’utilisation des antimicrobiens dans les aliments, toutefois, l’administration en pratique des animaux de compagnie, où les animaux sont en contact étroit avec leurs propriétaires, est aussi importante. Les praticiens pour petits animaux prescriront le plus probablement des antimicrobiens de classe 1 et 2, ceux qui sont les plus importants en médecine humaine. Or, les médecins vétérinaires doivent assumer la responsabilité de leurs actes dans tous les domaines de la pratique vétérinaire.

Le document du Cadre de travail panafricain sur la surveillance vétérinaire des antimicrobiens, qui a été publié par l’ACMV l’an dernier, a présenté le projet de l’Association pour un...
antimicrobial use data might be collected from veterinarians, veterinary practices, and places were antimicrobials are dispensed. The major goal of the workshop was to create consensus and identify the most relevant and easy-to-collect data as part of a prescription-based antimicrobial use surveillance program for small and food animals. Over 40 leaders of the veterinary community, covering 9 different areas of practice including small animal, food animal, equine, and aquaculture were all committed to finding solutions. The group explored major challenges to collecting data, including dispensing differences in various provinces, veterinary and client confidentially, and the differences in veterinary practice management software. There were significant challenges identified; however, the resolve from the veterinarians to address those obstacles was remarkable.

One of the first questions this group explored was “Why?” Why collect data on antimicrobial use? The collection of antimicrobial use data will support the federal government framework on AMR. One of the pillars of that framework is surveillance. But this is also being done to support the Canadian commitment to the World Organisation for Animal Health (OIE) and to show the international community that Canada is serious about addressing the AMR threat.

The CVMA has long been promoting pharmaceutical stewardship. In particular, we published Prudent Use Guidelines in 2008 and are currently undertaking a project to review and renew those guidelines. The federal government is supporting this project with funding through Growing Forward 2. We have also lobbied the federal government to continue moving forward in a timely manner with regulatory and policy changes that will improve antimicrobial stewardship.

Part of belonging to a profession is being stewards of that profession. Members protect the profession from threats that will damage the integrity of the profession. Antimicrobial resistance and the way antibiotics are used in animals is a threat to the integrity of the veterinary profession. We need to take action when there are obstacles to being good stewards. We must remain accountable to society to maintain our social contract and the right to use antimicrobials.

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Veterinary Medical Ethics
Déontologie vétérinaire

Ethical question of the month — May 2017

The use of animals for testing new pharmaceutical products that may prove effective in the treatment or prevention of serious human diseases is considered acceptable by a large proportion of Canadians, as well as citizens of many other countries. This is in contrast to the use of animals for testing the safety of cosmetics. Testing of cosmetics in animals is banned in all 27 countries in the European Union but is still performed in Canada. Is there an ethical basis for the continued testing of beauty products on animals in Canada? Can a veterinarian in good conscience work in laboratories performing this type of testing?

Question de déontologie du mois — Mai 2017

L’utilisation des animaux pour les essais de nouveaux produits pharmaceutiques qui pourraient s’avérer efficaces dans le traitement ou la prévention des maladies humaines graves est considérée acceptable par une grande proportion de Canadiens ainsi que par les citoyens de beaucoup d’autres pays. Cette situation contraste avec l’utilisation des animaux pour des tests d’innocuité des cosmétiques. Les tests de cosmétiques sur les animaux sont interdits dans les 27 pays de l’Union européenne, mais ils sont toujours réalisés au Canada. Existe-t-il des fondements éthiques pour poursuivre les tests des produits de beauté sur les animaux au Canada? Un médecin vétérinaire peut-il travailler en toute conscience dans des laboratoires qui effectuent ce type de tests?

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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 Dr’ 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 — February 2017

Several niche marketing programs forbid the use of antimicrobials in livestock production. This creates problems for producers and for the animals they care for. These niche marketing programs require that if an animal is treated with an antibiotic, it must be identified and removed from the niche marketing program. This creates an incentive for producers to “wait and see” if an animal can resolve an infection on its own. Regardless of the outcome, there is unnecessary suffering associated with the delay in treatment. This violates both the husbandry ethic as well as public expectations. If the stockperson eventually treats the animal, it seldom responds as well as it would have if the treatment has been given in a timely manner. Individual animals treated with an antimicrobial can be difficult to market. Irregular marketing of treated animals is time-consuming and often less profitable. As a result, “no antibiotic” marketing schemes have the potential to create negative effects on animal welfare. Can veterinarians be associated with no antibiotic niche programs and still adhere to their oath to prevent unnecessary animal suffering?

Question de déontologie du mois — Février 2017

Plusieurs programmes de marketing de créneau interdisent l’utilisation des antimicrobiens dans la production du bétail. Cela crée des problèmes pour les producteurs et les animaux dont ils s’occupent. Ces programmes de marketing de créneau exigent que, si un animal est traité à l’aide d’un antibiotique, il doit être identifié et retiré du programme de marketing de créneau. Cette situation incite les producteurs à attendre pour voir si un animal peut vaincre l’infection de lui-même. Sans égard au résultat, il se produit des souffrances inutiles lorsque l’on retardé le début du traitement, ce qui est contraire à l’éthique d’élevage ainsi qu’aux attentes du public. Si le préposé au bétail traite finalement l’animal, il répond rarement aussi bien que si le traitement avait été administré plus rapidement. Les animaux individuels traités à l’aide d’un antimicrobiens peuvent être difficiles à commercialiser. La commercialisation irrégulière des animaux traités est longue et souvent moins rentable.

An ethicist’s commentary on prudent use of antibiotics in livestock production

The pre-Socratic philosophers devoted a great deal of attention to trying to understand the nature of reality. Among these thinkers were Parmenides and Heraclitus, who espoused diametrically opposed views. Parmenides affirmed that if we truly understood reality, we would realize that it was ultimately unchanging — that change is an illusion. Heraclitus, on the other hand, argued that reality was constantly changing, metaphorically articulating his view as “one cannot step in the same river twice.” So far, so good.

Unfortunately, as is often the case, Heraclitus had disciples who carried his ideas one step too far. Prominent among these individuals was Cratylius, who affirmed that “one cannot step in the same river once,” which makes no sense whatsoever. A similar dynamic of carrying good ideas to absurdity is readily evident throughout our culture. Freud is not responsible for the excesses of the Freidians, nor Marx for the Marxists.

The implicit notion here is “zero tolerance.” This notion has been responsible for a great deal of mischief. Some years ago, one of the Colorado school districts announced a policy of “zero tolerance for weapons in schools.” A second grade child brought an orange to school along with a fruit knife packed by her mother to peel it. She was thrown out of school and suspended! This demonstrates that Cratylius is alive and well.

By the same token, those who question the excessive use of antibiotics as a method of growth promotion, or as a way of forcing farm animals into harmful environments that grossly violate their natures and harm their welfare in major ways make a powerful point, both from the standpoint of animal welfare, and as a result of the fact that such indiscriminate use inevitably drives the evolution of resistance to these powerful drugs.

As one who has served both on the Pew Commission, studying the consequences of the industrialization of agriculture, and on the World Health Organization commission charged with setting guidelines for rational use of antibiotics, I have encountered modern day examples of Cratylius-like extensions affirming that one should not use antibiotics for any purpose in animals, including treating disease.

In response to such an extreme position, my colleagues attempting to regulate excessive antibiotic use have univocally affirmed that it is part of our moral obligation to the animals we raise and care for not to let them suffer. Any traditional agriculturalist, raised in the ethic of animal husbandry, would be shocked and horrified at the suggestion that we allow the animals to suffer from treatable diseases.

Some years ago, in this column, I debated the organic zealots who refused to use antibiotics to treat highly painful foot rot in cattle, even if the animals were removed from the food supply well after the government prescribed clearance period. As far as I’m concerned, such behavior has everything to do with marketing and nothing whatever to do with rational use of antimicrobials.

Indeed, if the general public became aware that conspicuous denial of antibiotic use was not rationally based, but rather was a self-righteous marketing tactic resulting in considerable suffering, the zealots would not fare well.
In my view, it is part of the moral charge to veterinarians to explain the situation to the general public, and in particular to point out that their own primary obligation as veterinarians is not to allow preventable animal suffering. Just as society would not prevent the use of antibiotics to treat sick people, so too the therapeutic use of antibiotics in animals should not be forestalled. As the veterinary profession has itself pointed out, veterinarians should be the guardians of animal welfare when the animals are used in society. One could also argue that failure to use an effective medication for sick animals would constitute a form of malpractice.

This may mean falling afoul of the Cratylus types. But as someone once said to me, if behaving with integrity was easy, everyone would be doing it. A well-placed word to the producers about what it would look like to the public if the sick animals were not treated might go a long way to help change their attitude.

Bernard E. Rollin, PhD

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Travel to beautiful Charlottetown, P.E.I. as we host the 2017 CVMA Convention. Join 500+ veterinarians and clinic staff attending this convention and be excited by signature events, stellar speakers, wet labs and much more!
1. A 6-year-old shih-tzu presents with polyuria, polydipsia, alopecia, and a pot-bellied appearance. She has been receiving daily oral prednisolone for the past 8 months. Results of an ACTH response test are as follows: baseline cortisol, 15 nmol/L (reference range: 15 to 110 nmol/L), and post-ACTH cortisol, 24 nmol/L (reference range: 220 to 550 nmol/L). The most likely diagnosis is which of the following?
   A. Iatrogenic hyperadrenocorticism
   B. Hypoadrenocorticism
   C. Hyperadrenocorticism resulting from a pituitary tumor
   D. Hyperadrenocorticism resulting from an adrenal tumor
   E. A sex-steroid-secreting adrenal tumor

2. Which of the following is true regarding feline immunodeficiency virus (FIV)?
   A. It is most prevalent in kittens younger than 4 months of age.
   B. Ocular disorders are not associated with FIV.
   C. Chronic and recurrent infections are common.
   D. Cats start to exhibit clinical signs within 48 hours of infection.
   E. Most infections occur via transplacental transmission.

3. Which of the following is INCORRECT regarding rabies?
   A. Clinical signs usually occur within 2 to 8 weeks of exposure.
   B. Virus is shed in saliva only after clinical signs start.
   C. Death occurs 3 to 10 days after the onset of clinical signs.
   D. A direct fluorescent antibody test on brain or salivary gland is the test of choice.
   E. Vaccination is protective.

4. Which of the following is the most likely diagnosis for a horse with a history of anorexia, depression, hyponatremia, and exogenous administration of glucocorticoids?
   A. Adrenal insufficiency
   B. Diabetes insipidus
   C. Goiter
   D. Cushing’s disease

1. Une chienne Shih-tzu âgée de 6 ans souffre de polyurie, de polydipsie, d’abattement et présente un abdomen distendu. Depuis 8 mois, elle reçoit quotidiennement de la prednisolone par voie orale. Les résultats d’un test réponse à l’ACTH sont les suivants : cortisol initial de base, 15 nmol/L (étendue de référence : 15 à 110 nmol/L), cortisol post ACTH, 24 nmol/L (étendue de référence : 220 à 550 nmol/L). Lequel des diagnostics suivants est le plus probable?
   A. hyperadrénocorticisme iatrogène;
   B. hypoadrénocorticisme;
   C. hyperadrénocorticisme résultant d’une tumeur hypophysaire;
   D. hyperadrénocorticisme résultant d’une tumeur surrénalienne;
   E. tumeur surrénalienne sécrétant un stéroïde sexuel.

2. Lequel des énoncés suivants est vrai à propos du virus de l’immunodéficience féline?
   A. Il est le plus prévalent chez les chatons âgés de moins de 4 mois.
   B. Les problèmes oculaires ne sont pas associés au virus de l’immunodéficience féline.
   C. Des infections chroniques et à répétition sont communes.
   D. Les chats commencent à démontrer des signes cliniques dans les 48 heures suivant le début de l’infection.
   E. La plupart des infections se produisent par transmission transplacentaire.

3. Lequel des énoncés suivants est INCORRECT à propos de la rage?
   A. Les signes cliniques se manifestent de 2 à 8 semaines après l’exposition au virus.
   B. Le virus est libéré dans la salive seulement après l’apparition des signes cliniques.
   C. La mort se produit de 3 à 10 jours après le début des signes cliniques.
   D. Une réaction d’immunofluorescence directe sur l’encéphale ou la salive est l’épreuve diagnostique de choix.
   E. La vaccination offre une protection adéquate.
5. Which of the following is NOT an appropriate review when a sudden increase in the incidence of coliform mastitis occurs?
A. Feed delivery relative to milking time
B. Culture of all cows with grossly normal milk and elevated somatic cell count
C. Udder preparation procedures by parlor staff
D. Manure removal from barns and re-bedding frequency of stalls
E. Administration protocol for *Escherichia coli* bacterins

4. Lequel des diagnostics suivants est le plus probable chez un cheval qui présente une anamnèse d’anorexie, d’abattement, d’hyponatrémie et d’administration de glucocorticoides exogènes?
A. insuffisance surrenaliennne;
B. diabète insipide;
C. goître;
D. maladie de Cushing.

5. Laquelle des procédures suivantes N’EST PAS appropriée lorsqu’une augmentation soudaine dans l’incidence de mammite à coliforme se produit?
A. présentation de la nourriture relativement à la traite;
B. culture de toutes les vaches ayant du lait macroscopiquement normal et une numération élevée des cellules somatiques;
C. procédures de préparation du pis par les préposés du salon de traite;
D. enlèvement du fumier des étables et mise en place fréquente de litière dans les enclos;
E. protocole d’administration de bactérines d’*Escherichia coli*.

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, and Ancillary Topics, by kind permission of the publisher, Mosby–Year Book, Inc., St. Louis, Missouri.
CVMA Council Update

The March Council meeting was part of the annual CVMA Committee Weekend at which 68 participants represented the CVMA’s standing committees namely the Animal Health Technology/Veterinary Technician Program Accreditation Committee (AHTVTPAC), Animal Welfare Committee (AWC), Editorial Committee, National Examining Board (NEB), National Issues Committee (NIC), and the Professional Development Committee (PDC). The CVMA is proud of the support of over 600 volunteers who help to serve and represent the profession.

The CVMA Council, consisting of representatives from all provinces, student veterinarians, veterinary colleges and veterinary technicians, welcomed the following new members: Dr. Christiane Armstrong (British Columbia), Dr. Chris Bell (Manitoba) and Dr. Karin Machin (Manitoba) and newly appointed as Canada’s World Officer of Canada and associate vice-president, Canadian Food Inspection Agency (CFIA) and newly appointed as Canada’s World Organization for Animal Health (OIE) delegate, and Dr. Manisha Mehrotra, director, Veterinary Drugs Directorate (VDD).

Strategic planning: The CVMA conducts its priority area strategic planning in a 4-year cycle. The CVMA’s priorities are National & International Issues, Animal Welfare, and A Successful Career, A Balanced Life. This year, Council participated in a Strategic Planning Session on A Successful Career, A Balanced Life and discussed such matters as business and financial management, veterinary wellness, and mentorship. A survey of approximately 140 selected veterinarians, conducted prior to the session, provided additional input in this needs assessment.

During the upcoming CVMA Summit, scheduled for July 13 during the 2017 CVMA Convention in Charlottetown, Prince Edward Island, participants will be discussing the “Uber” of veterinary practice, followed by a National Issues Forum entitled Is Alternative Medicine No Longer an Alternative? Building on

Mise à jour du Conseil de l’ACMV

La réunion de mars du Conseil a fait partie de la fin de semaine annuelle des comités de l’ACMV à laquelle 68 participants ont représenté les comités permanents de l’ACMV, notamment le Comité d’agrément des programmes de technologie en santé animale et de techniques vétérinaires (CAPTSATV), le Comité sur le bien-être animal (CBA), le Comité de la rédaction, le Bureau national des examinateurs (BNE), le Comité sur les enjeux nationaux (CEN) et le Comité du perfectionnement professionnel (CPP). L’ACMV est fière du soutien de ses plus de 600 bénévoles qui contribuent au service et à la représentation de la profession.

Le Conseil de l’ACMV, qui se compose de représentants de toutes les provinces, des étudiants en médecine vétérinaire, des facultés de médecine vétérinaire et des techniciens vétérinaires, a accueilli les nouveaux membres suivants : D’* Dr. Harpreet Kochhar, chef vétérinaire en chef du Canada et vice-président associé de l’Agence canadienne d’inspection des aliments (ACIA) et délégué du Canada récemment nommé auprès de l’Organisation mondiale de la santé animale (OIE), et la D’* Dr. Manisha Mehrotra, directrice, Direction des médicaments vétérinaires (DMV).

Planification stratégique : L’ACMV effectue sa planification stratégique des domaines prioritaires selon un cycle de quatre ans. Les priorités de l’ACMV sont les enjeux nationaux et internationaux, le bien-être animal et une carrière prospère, une vie équilibrée. Cette année, le Conseil a participé à un atelier de planification stratégique sur une carrière prospère, une vie équilibrée, et a discuté des questions comme la gestion commerciale et financière, le bien-être vétérinaire et le mentorat. Un sondage réalisé auprès d’environ 140 médecins vétérinaires choisis, qui a été effectué avant l’atelier, a fourni des renseignements additionnels pour cette évaluation des besoins.

Durant le Sommet de l’ACMV à venir, qui est prévu le 13 juillet durant le congrès 2017 de l’ACVM qui aura lieu à Charlottetown, à l’Île-du-Prince-Édouard, les participants discutent de l’«Uber» de la pratique de la médecine vétérinaire, qui sera suivi d’un Forum sur les enjeux nationaux intitulé «La médecine parallèle est-elle toujours parallèle?» en misant sur ce thème, le Conseil prévoit entreprendre une planification stratégique élargie en 2017 afin d’aborder les nouvelles réalités de la profession et de déterminer les façons dont l’ACVM peut mieux représenter et desservir la profession dans ce nouveau contexte.

Surveillance vétérinaire de l’utilisation des antimicrobiens — Un cadre de travail pancanadien pour les normes professionnelles régissant les médecins vétérinaires : Ce cadre de travail, qui a été élaboré par l’ACMV en collaboration avec le Conseil canadien des registraires vétérinaires (CCRV), fournit un modèle pour les normes professionnelles qui seront utilisées par les organismes provinciaux et territoriaux de réglementation de la
this theme, Council is planning to undertake broader strategic planning in 2017 to address new realities in the profession and how the CVMA can better represent and serve the profession in such a new context.

**Veterinary Oversight of Antimicrobial Use — a Pan-Canadian Framework of Professional Standards for Veterinarians:** This Framework, developed by the CVMA in collaboration with the Canadian Council of Veterinary Registrars (CCVR) provides a template of professional standards to be used by provincial and territorial veterinary licensing bodies when developing their own regulations, guidelines, or bylaws relating to the responsibilities of the veterinary profession in providing oversight in the use of antimicrobials. An Executive Summary and the detailed Framework were distributed to all CVMA members in January 2017.

**AMU surveillance:** Addressing antimicrobial resistance (AMR) is a priority for the World Health Organization (WHO), the OIE, the United Nations, the G20, G7, the Canadian federal government and the veterinary profession. Prudent use, and as much as appropriate, the reduction of antimicrobial use (AMU) are important for the health and welfare of the public and animals alike. Prudent AMU is important for international trade and a requirement by society in general.

With a funding contribution from CFIA, the CVMA is working on the development of quantitative AMU data collection for large and small animal practices. On February 28 and March 1, the CVMA hosted a preliminary workshop that brought together over 50 stakeholders. The objective of the workshop was to engage stakeholders and discuss a minimum data set and how such data could be collected. Depending on the availability of funding and input by the federal government, the next steps may include a survey to establish baseline data leading to a surveillance system, the goal of which would be the reduction of antimicrobial use.

**Antimicrobial Prudent Use Guidelines:** The CVMA started with the renewal of its 2008 Food Animal Prudent Use Guidelines and is continuing the development of online Small medicine veterinary lorsqu'ils élaboreront leurs propres règlements ou lignes directrices portant sur les responsabilités de la profession vétérinaire dans la supervision de l'utilisation des antimicrobiens. Un sommaire et le cadre de travail ont été distribués à tous les membres de l'ACMV en janvier 2017.


Grâce à une contribution financière de l'ACIA, l'ACMV travaille à l'élaboration d'une collecte quantitative des données sur l'utilisation des antimicrobiens pour les pratiques pour grands et petits animaux. Le 28 février et le 1er mars, l'ACMV a organisé un atelier préliminaire qui a réuni plus de 50 intervenants. L'atelier avait pour objectif d'engager les intervenants et de discuter d'un ensemble minimum de données et de la façon dont ces données pourraient être recueillies. Selon la disponibilité des fonds et la rétroaction du gouvernement fédéral, les prochaines étapes pourraient inclure un sondage afin d'établir les données de référence qui mèneront à la création d'un système de surveillance ayant pour but de réduire l'utilisation des antimicrobiens.

**Lignes directrices sur l’administration judicieuse des antimicrobiens** : L’ACMV a amorcé le renouvellement de ses Lignes directrices sur l’administration judicieuse des antimicrobiens pour les animaux destinés à l’alimentation de 2008 et elle poursuit la rédaction de ses Lignes directrices sur l’administration judicieuse des antimicrobiens pour les petits animaux. On prévoit que ces travaux seront finalisés d’ici mars 2018. Avant le début des travaux des experts en la matière, on procédera à une consultation des intervenants afin d’identifier leurs besoins.

**Communication sur l’utilisation des antimicrobiens** : L’ACMV poursuit sa campagne de sensibilisation mensuelle ciblant les...
Animal Prudent Use Guidelines. This work is scheduled to be finalized by March 2018. Before subject matter experts begin their work, stakeholders will be consulted to identify their needs.

AMU communication: The CVMA is continuing its monthly AMR Awareness Campaign targeting veterinarians and will add some emphasis on AMR in small animals.

OIE country assessment: The CFIA is preparing for an evaluation of the performance of Canadian veterinary services by the OIE. This evaluation will assess Canada’s veterinary capacity from the federal and provincial regulatory perspective, as well as the perspective of emergency preparedness and the veterinary practice. The OIE site visit took place from March 13 to 31, 2017. A few large and small animal veterinary practices were selected randomly by the site visit team for assessment. The OIE report and recommendations are expected in the summer of 2017. The CVMA participated in the OIE training session and assisted the CFIA task team preparing for this assessment.

Importation of rescue dogs: The CVMA’s position statement, as approved by Council in November 2016, has been distributed to the veterinary community. The CVMA is planning advocacy steps with the government on the issue and developing an information campaign targeted at veterinarians and the public.

Federal animal cruelty legislation: Following the defeat of Bill C-246, the CVMA continued to meet with the Bill’s author, Member of Parliament (MP) Nathaniel Erskine-Smith, to discuss next steps. Mr. Erskine-Smith explained that in its future review of the animal cruelty legislation, the government will be looking for evidence-based arguments. The Liberal party, under Quebec MP Alexandra Mendes, has established a caucus of 23 liberal MPs to consider the changes needed for future animal cruelty legislation. This caucus will invite the CVMA to discuss the future animal cruelty legislation. The CVMA is also considering a meeting with the office of the Minister of Justice.

Kennel Code: The AWC is completing the draft revision of the Code. The key sections are Animal Environment (accommodation, housing and handling facilities); Food and Water; Husbandry Practices; Transport; Euthanasia; Annexes; and References. The Code will serve as a guide for all kennel operators. The Code is scheduled to be released later in 2017.

First Nations: A task force struck by the CVMA Council has started talks with Veterinarians without Borders (VWB) to identify how the CVMA could assist in improving the accessibility to veterinary services within First Nations and Northern communities. The CVMA has provided VWB with a venue for a workshop on Friday, July 14, 2017, 1:30–6:30 pm during the CVMA Convention. The Workshop will aid in identifying the issues and gaps that will be taken into account when formulating a strategy. The workshop ties nicely into the CVMA’s morning continuing education (CE) program addressing such issues as Remote Veterinary Care in Rural Canadian Communities, Student Run Veterinary Clinics, and Accessible Veterinary Care.

Canadian Veterinary Reserve (CVR): The CVR has embarked on a recruitment campaign and has added 65 reservists over the past few months, reaching a total number of 278; the aim is to reach a total of 300. The CVR was involved with the Public Health Agency of Canada (PHAC) in the Beyond
the Border project, coordinating emergency preparedness and response in the United States and Canada, for both humans and animals. As an outcome of this project, the CVR is now hosting 16 online emergency preparedness modules provided by the US Department of Health and Human Services free of charge. The CVR held its annual call-up drill in March, which involved CFIA and Emergency Management British Columbia. The drill tested the response of reservists and the operational readiness of the CVR.

**Transportation of Dogs and Cats:** Council approved the revised position statement as follows:

“The Canadian Veterinary Medical Association (CVMA) strongly recommends that if dogs and cats are to be transported by a conveyance that it is done in a manner that ensures the safety, security, health and welfare of the animal and the public safety.”

**Animal Health Technology/Veterinary Technician Program Accreditation:** Council approved the extension of accreditation to the Seneca College Veterinary Technician Program in King City, Ontario and the Oulton College Veterinary Technician Program in Moncton, New Brunswick.

**Students of the CVMA (SCVMA):** The SCVMA hosted its annual Symposium at the University of Calgary. Approximately 200 students attended. The post-Symposium survey indicated a satisfaction rate of 97%. The 2018 SCVMA Symposium will be held on January 19–20 at the Atlantic Veterinary College.

The first **SCVMA Leadership Workshop** took place at the Faculté de médecine vétérinaire in November 2016 and was attended by almost 60 students. The next SCVMA workshop is scheduled for November 2017 at the Ontario Veterinary College. This Leadership Workshop serves as a precursor to the CVMA's Emerging Leaders Workshop, which takes place annually during the CVMA Convention.

**CVMA Awards:** Council selected the following winners of the 2017 Awards:

- Small Animal Practitioner Award: Dr. David Condon
- Merck Veterinary Award: Dr. Stephen LeBlanc
- Humane Award: Dr. Anne McDonald
- Practice of the Year Award: Mona Campbell Centre for Animal Cancer
- Life Membership: Dr. Jeanne Lofstedt
- RVL Walker Award: Ms. Elizabeth Hartnett

The Awards Ceremony will take place during the upcoming Convention in Charlottetown, on July 13, following the CVMA Annual General Meeting.

**CVMA Convention:** The 2017 CVMA Convention will take place from July 13–16 in Charlottetown, Prince Edward Island. The Convention will offer 7 wet labs and over 100 sessions facilitated by over 40 speakers. The CE is again approved by the Registry of Approved CE (RACE) administered by the American Association of Veterinary State Boards in which most Canadian licensing bodies are members.

See you in Charlottetown!

(by Jost am Rhyn, CEO, CVMA)

par-delà la frontière afin de coordonner la préparation aux situations d'urgence et les interventions aux États-Unis et au Canada, tant pour les humains que pour les animaux. Dans le cadre de ce projet, la RVC présente maintenant 16 ateliers de préparation aux situations d’urgence qui sont offerts en ligne et fournis gratuitement par le ministère de la Santé et des Services humains des États-Unis. La RVC a tenu son exercice annuel de mobilisation en mars auquel ont participé l’ACIA et l’organisation de gestion des urgences de la Colombie-Britannique. L’exercice a mis à l’épreuve la réponse des réservistes et la préparation opérationnelle de la RVC.

**Transport des chiens et des chats** : Le Conseil a approuvé l’arrêté de position suivant comme suit :

«L’Association canadienne des médecins vétérinaires (ACMV) recommande vivement que les chiens et les chats soient transportés dans un mode de transport qui assure la sécurité du public et protège la sécurité, la santé et le bien-être de l’animal.»

**Agrement des programmes de technologie de la santé animale et des techniques vétérinaires** : Le Conseil a approuvé le prolongement de l’agrément du Programme de techniques vétérinaires de Seneca College à King City, en Ontario, et du Programme de techniques vétérinaires d’Oulton College à Moncton, au Nouveau-Brunswick.


Le premier **Atelier de leadership des ÉACMV** a eu lieu à la Faculté de médecine vétérinaire de l’Université de Montréal en novembre 2016 et près de 60 étudiants y ont assisté. Le prochain atelier des ÉACMV est prévu pour novembre 2017 à l’Ontario Veterinary College. Cet atelier de leadership sert de précurseur à l’Atelier des futurs leaders de l’ACMV qui se déroule chaque année durant le congrès de l’ACMV.

**Prix de l’ACMV** : Le Conseil a choisi les lauréats suivants pour les Prix 2017 :

- Prix du praticien des petits animaux : D' David Condon
- Prix vétérinaire Merck : Dr Stephen LeBlanc
- Prix humanitaire : D' Anne McDonald
- Prix de la pratique de l’année : Mona Campbell Centre for Animal Cancer
- Titre de membre à vie : D’ Jeanne Lofstedt
- Prix RVL Walker : Mme Elizabeth Hartnett

La cérémonie de remise des prix se déroulera le 13 juillet, durant le prochain congrès à Charlottetown, après l'Assemblée générale annuelle de l’ACMV.

**Congrès de l’ACMV** : Le congrès 2017 de l'ACMV se déroulera du 13 au 16 juillet à Charlottetown, à l’Île-du-Prince-Édouard. Le congrès offrira sept laboratoires de travaux pratiques et plus de 100 ateliers animés par plus de 40 conférenciers. De nouveau, la formation continue a été approuvée par le Registry of Approved Continued Education (RACE) qui est administré par l'American Association of Veterinary State Boards dont sont membres la plupart des organismes de réglementation du Canada.

Au plaisir de vous rencontrer à Charlottetown!

(by Jost am Rhyn, PDG, ACMV)
CVMA’s Emerging Leaders Program
Programme des futurs leaders de l’ACMV

Last summer I was lucky to be one of 34 participants in the CVMA’s Emerging Leaders Program (ELP) at the CVMA’s annual Convention in beautiful Niagara Falls, Ontario. I would like to start by thanking Virox Animal Health for sponsoring this workshop. It is a wonderful addition to the CVMA Convention, and your generous sponsorship is invaluable.

Over the course of this 8-hour, 2-day workshop, Dr. Rick DeBowes, professor of Surgery and director of the Professional Life Skills Program at Washington State University — College of Veterinary Medicine, highlighted some veterinary practice challenges and guided participants on how to overcome these challenges by applying leadership and teamwork concepts. Dr. DeBowes has also practiced in private small animal medicine and academic equine practice settings. He is a frequent speaker at various leadership programs, and was a co-founder of the American Veterinary Medical Association (AVMA) Veterinary Leadership Conference (VLC) and a series of other interactive leadership education experiences for health care teams.

The CVMA ELP gives participants tools to effectively cope with veterinary practice challenges as part of a professional medical team, and to help find a good work/life balance.

Through presentations, videos and interactive activities, Dr. DeBowes takes the focus off the profession’s medical aspect, and shifts it to workplace communication. My favorite part of this experience was the interactive group activities, as they highlighted the importance of effective communication strategies when approaching problems. The lessons learned in this workshop would benefit any veterinarian, whether a recent graduate or an experienced practitioner.

Le PFL de l’ACMV donne aux participants les outils afin de gérer efficacement les défis de la pratique vétérinaire au sein d'une équipe médicale professionnelle et d'atteindre un bon équilibre travail-vie.

Dans le cadre de présentations, de vidéos et d’activités interactives, le Dr DeBowes, au lieu d’insister sur l’aspect médical de la profession, examine la communication en milieu de travail. Ce que j’ai le mieux aimé de cette expérience? Les activités de
This year the 2017 CVMA ELP will be held July 13–14 at the CVMA Convention, in beautiful Charlottetown, Prince Edward Island. Any CVMA or Registered Veterinary Technologists and Technicians of Canada (RVTTC) member is welcome to register for this fantastic workshop. CVMA members who graduated within the past 10 years are encouraged to apply for full event sponsorship to attend. Sponsored participants receive travel to and from Charlottetown, 2 nights’ accommodation at the Delta Prince Edward Hotel, an 8-hour workshop with Dr. Rick DeBowes and a complimentary 2017 CVMA Convention registration (value $645). Up to 2 sponsored participants will be selected per province.

For more information, testimonials from past participants, or to register or apply for sponsorship, please visit the CVMA website (www.canadianveterinarians.net/science-knowledge/emerging-leaders-program)!

(by Traci Henderson, SCVMA representative, WCVM)

Les membres du Conseil de l’ACMV rencontrent des participants du PFL.

groupe interactives, car elles soulignaient l’importance de stratégies efficaces de communication pour la résolution de problèmes. Les leçons apprises dans cet atelier seront utiles à tous les médecins vétérinaires, qu’il s’agisse d’un diplômé récent ou d’un praticien chevronné.

Cette année, le PFL 2017 de l’ACMV se tiendra les 13 et 14 juillet au congrès de l’ACMV, dans la splendide ville de Charlottetown, à l’Île-du-Prince-Édouard. Les membres de l’ACMV ou de Technologues et techniciens vétérinaires agréés du Canada (TTVAC) sont invités à s’inscrire à cet atelier exceptionnel. Les membres de l’ACMV qui ont obtenu leur diplôme au cours des dix dernières années sont encouragés à présenter une demande pour une pleine commandite afin d’assister à l’événement. Les participants commandités recevront le transport aller-retour à Charlottetown, deux nuitées à l’hôtel Delta Prince Edward, un atelier de huit heures avec le Dr. Rick DeBowes et une inscription gratuite au congrès 2017 de l’ACMV (valeur de 645 $). Jusqu’à deux participants seront choisis par province.

Pour en savoir davantage, lire des témoignages d’anciens participants ou vous inscrire ou présenter une demande de commandite, veuillez visiter le site Web de l’ACMV (www.veterinairesaucanada.net/science-knowledge/emerging-leaders-program)!

(par Traci Henderson, représentante des ÉACMV, WCVM)
SCVMA New Graduate Survey Report: Class of 2016
Rapport sur le sondage auprès des finissants des ÉACMV : promotion 2016

The Students of the Canadian Veterinary Medical Association (SCVMA) annually survey recent Canadian veterinary college graduates and report on current Canadian veterinary workforce conditions. This year’s survey response rate was 43% (n = 146), with 87% of respondents being female. Please note, some respondents did not answer every question.

Demographics
Figure 1. Graduating College (n = 144).

Employment data
The employment data collected showed that 98% (n = 143) of respondents have been employed since graduation and the 3 respondents’ reasons they are not working in the veterinary field since graduation are that 1 is furthering their education (masters, PhD), 1 isn’t working because of children and 1 decided to take a break.

Données démographiques
Figure 1. École d'obtention du diplôme (n = 144).

Données sur l'emploi
Les données recueillies sur l'emploi ont montré que 98 % (n = 143) des répondants travaillaient depuis la fin du cours et, parmi les trois répondants qui ne travaillaient pas dans le domaine vétérinaire depuis la fin des études, un répondant poursuivait ses études (maîtrise, doctorat), un répondant ne travaillait pas pour des raisons de famille et un répondant a décidé de prendre une pause.
If you are working in the veterinary field, did you secure this position before graduation?

In 2016, 84% of respondents \((n = 140)\) secured their position before graduation, 73% \((n = 107)\) in 2015 and 76% \((n = 106)\) in 2014.

Are you still working in the position you accepted following graduation \((n = 139)\)?

Among the 7 veterinarians no longer working in the position they accepted before graduation, 3 did not like their employer, 1 did not like the position, and 3 found better jobs.

Successful search methods used in securing current employment \((n = 149)\).

<table>
<thead>
<tr>
<th>Method</th>
<th>Number of respondents</th>
<th>%</th>
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<td>CVMA/The Canadian Veterinary Journal classifieds</td>
<td>13</td>
<td>9%</td>
</tr>
<tr>
<td>Provincial veterinary medical association classifieds</td>
<td>37</td>
<td>25%</td>
</tr>
<tr>
<td>Networking</td>
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<td>15%</td>
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<tr>
<td>Internships</td>
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<tr>
<td>Worked there as an undergraduate</td>
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<td>17%</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>19</td>
<td>13%</td>
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</tbody>
</table>

Some of the other methods used in securing current employment were e-mails from the colleges, a partner worked at the clinic, a classmate’s recommendation, dropping off resumes, and positions were secured there during 4th-year rotations.

The methods of search that were successful in securing current employment included:

- CVMA/The Canadian Veterinary Journal classifieds
- Provincial veterinary medical association classifieds
- Networking
- Internships
- Internet searches
- Worked there as an undergraduate
- Other (please specify)

Some of the other methods used in securing current employment were e-mails from the colleges, a partner worked at the clinic, a classmate’s recommendation, dropping off resumes, and positions were secured there during 4th-year rotations.

The methods of search that were successful in securing current employment included:

- CVMA/The Canadian Veterinary Journal classifieds
- Provincial veterinary medical association classifieds
- Networking
- Internships
- Internet searches
- Worked there as an undergraduate
- Other (please specify)

Certaines des autres méthodes utilisées pour trouver un emploi étaient des courriels provenant des écoles, un partenaire travaillait à la clinique, la recommandation d’un camarade de classe, la remise en curriculum vitae et des postes qui étaient obtenus lors des rotations de quatrième année.
Respondents were asked approximately how many hours per week they work and the average was 45 hours per week. Respondents were also asked how many full-time and part-time veterinarians work at their practice and the average number of full-time veterinarians per clinic was 4 and the average number of part-time veterinarians per clinic was 1.

On a demandé aux répondants le nombre approximatif d’heures travaillées par semaine et la moyenne était de 45 heures par semaine. On a aussi demandé aux répondants combien de vétérinaires à temps plein et à temps partiel travaillaient à leur pratique et le nombre moyen de vétérinaires à temps plein par clinique était de 4 et le nombre moyen de vétérinaires à temps partiel était de 1.
Figure 8. Veuillez indiquer le pourcentage de temps que vous consacrez à ces espèces (n = 138).

<table>
<thead>
<tr>
<th>Espèce</th>
<th>% du temps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volaille</td>
<td>1 %</td>
</tr>
<tr>
<td>Oiseaux et oiseaux en cage</td>
<td>2 %</td>
</tr>
<tr>
<td>Bovins — bœufs de boucherie</td>
<td>3,5 %</td>
</tr>
<tr>
<td>Bovins — bovins laitiers</td>
<td>12 %</td>
</tr>
<tr>
<td>Bovins — veaux</td>
<td>0,5 %</td>
</tr>
<tr>
<td>Petits ruminants</td>
<td>1,5 %</td>
</tr>
<tr>
<td>Gibier d'élevage</td>
<td>0 %</td>
</tr>
<tr>
<td>Chiens</td>
<td>47,5 %</td>
</tr>
<tr>
<td>Équidés</td>
<td>14,5 %</td>
</tr>
<tr>
<td>Féliniés</td>
<td>39,5 %</td>
</tr>
<tr>
<td>Porcins</td>
<td>1 %</td>
</tr>
<tr>
<td>Autres</td>
<td>8,5 %</td>
</tr>
<tr>
<td>Autres espèces</td>
<td>3 %</td>
</tr>
</tbody>
</table>

On a demandé aux finissants s’ils suivaient le même cheminement de carrière qu’ils avaient prévu au moment de l’obtention du diplôme et 90 % (n = 124) ont répondu oui et 10 % (n = 14) ont répondu non. Les raisons pour lesquelles 10 % des répondants ne suivaient pas le même cheminement de carrière étaient que leurs intérêts avaient changé durant le cours vétérinaire, qu’il n’y avait pas beaucoup d’emplois dans le domaine prévu, des changements dans la vie personnelle et qu’ils avaient commencé dans un domaine différent et ont réalisé qu’ils y étaient heureux.

Figure 9. Dans quelle province ou territoire travaillez-vous actuellement?

<table>
<thead>
<tr>
<th>Province/Territoire</th>
<th>Nombre de répondants (n = 137)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alberta</td>
<td>23</td>
<td>16,8 %</td>
</tr>
<tr>
<td>Colombie-Britannique</td>
<td>16</td>
<td>11,7 %</td>
</tr>
<tr>
<td>Île-du-Prince-Édouard</td>
<td>2</td>
<td>1,5 %</td>
</tr>
<tr>
<td>Manitoba</td>
<td>2</td>
<td>1,5 %</td>
</tr>
<tr>
<td>Nouveau-Brunswick</td>
<td>2</td>
<td>1,5 %</td>
</tr>
<tr>
<td>Nouvelle-Écosse</td>
<td>5</td>
<td>3,6 %</td>
</tr>
<tr>
<td>Nunavut</td>
<td>0</td>
<td>0 %</td>
</tr>
<tr>
<td>Ontario</td>
<td>42</td>
<td>30,7 %</td>
</tr>
<tr>
<td>Québec</td>
<td>27</td>
<td>19,7 %</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>12</td>
<td>8,8 %</td>
</tr>
<tr>
<td>Terre-Neuve-et-Labrador</td>
<td>1</td>
<td>0,7 %</td>
</tr>
<tr>
<td>Territoires du Nord-Ouest</td>
<td>0</td>
<td>0 %</td>
</tr>
<tr>
<td>Yukon</td>
<td>0</td>
<td>0 %</td>
</tr>
<tr>
<td>International</td>
<td>5</td>
<td>3,6 %</td>
</tr>
</tbody>
</table>

Dans ces provinces, 61 % des répondants (n = 127) travaillent dans une pratique urbaine et 39 % travaillent dans une pratique rurale.
Income and compensation data

Figure 10. Mean annual salary ($CDN) by province.
(n = number of respondents)

<table>
<thead>
<tr>
<th>Province</th>
<th>Salary ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>British Columbia (n = 16)</td>
<td>73,375.00</td>
</tr>
<tr>
<td>Ontario (n = 42)</td>
<td>61,338.33</td>
</tr>
<tr>
<td>Alberta (n = 21)</td>
<td>60,166.67</td>
</tr>
<tr>
<td>Saskatchewan (n = 11)</td>
<td>59,727.72</td>
</tr>
<tr>
<td>Quebec (n = 30)</td>
<td>47,783.33</td>
</tr>
<tr>
<td>International (n = 5)</td>
<td>58,200.00</td>
</tr>
<tr>
<td>Manitoba (n = 2)</td>
<td>71,500.00</td>
</tr>
<tr>
<td>New Brunswick (n = 2)</td>
<td>55,000.00</td>
</tr>
<tr>
<td>Nova Scotia (n = 5)</td>
<td>60,000.00</td>
</tr>
<tr>
<td>Newfoundland and Labrador (n = 1)</td>
<td>142,000.00</td>
</tr>
<tr>
<td>Prince Edward Island (n = 1)</td>
<td>24,000.00</td>
</tr>
</tbody>
</table>

Figure 11. Compensation method.

<table>
<thead>
<tr>
<th>Compensation method</th>
<th>% of respondents</th>
<th>Number of respondents (n = 138)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straight salary</td>
<td>83.3%</td>
<td>115</td>
</tr>
<tr>
<td>Base salary plus a percentage of your gross earnings or billings</td>
<td>16.6%</td>
<td>23</td>
</tr>
<tr>
<td>Income based on a percentage of your gross earnings</td>
<td>0%</td>
<td>0</td>
</tr>
</tbody>
</table>

Figure 12. Average student debt upon graduation ($CDN) according to the veterinary college and graduation year.
(n = number of respondents by college).

<table>
<thead>
<tr>
<th>College</th>
<th>Debt 2016</th>
<th>Debt 2015</th>
<th>Debt 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVC</td>
<td>$91,590 n = 18</td>
<td>$101,454 n = 11</td>
<td>$140,421 n = 19</td>
</tr>
<tr>
<td>FMV</td>
<td>$32,930 n = 28</td>
<td>$19,687 n = 24</td>
<td>$31,220 n = 25</td>
</tr>
<tr>
<td>OVC</td>
<td>$54,950 n = 39</td>
<td>$43,184 n = 33</td>
<td>$55,133 n = 30</td>
</tr>
<tr>
<td>UCVM</td>
<td>$70,550 n = 8</td>
<td>$74,083 n = 12</td>
<td>$51,446 n = 13</td>
</tr>
<tr>
<td>WCVM</td>
<td>$50,190 n = 42</td>
<td>$47,111 n = 27</td>
<td>$50,500 n = 26</td>
</tr>
</tbody>
</table>

Données sur le revenu et la rémunération

Figure 10. Salaire annuel moyen ($CAN) par province.
(n = nombre de répondants)

<table>
<thead>
<tr>
<th>Province</th>
<th>Salaire ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombie-Britannique (n = 16)</td>
<td>73 375,00 $</td>
</tr>
<tr>
<td>Ontario (n = 42)</td>
<td>61 338,33 $</td>
</tr>
<tr>
<td>Alberta (n = 21)</td>
<td>60 166,67 $</td>
</tr>
<tr>
<td>Saskatchewan (n = 11)</td>
<td>59 727,72 $</td>
</tr>
<tr>
<td>Québec (n = 30)</td>
<td>47 783,33 $</td>
</tr>
<tr>
<td>International (n = 5)</td>
<td>58 200,00 $</td>
</tr>
<tr>
<td>Manitoba (n = 2)</td>
<td>71 500,00 $</td>
</tr>
<tr>
<td>Nouveau-Brunswick (n = 2)</td>
<td>55 000,00 $</td>
</tr>
<tr>
<td>Nouvelle-Écosse (n = 5)</td>
<td>60 000,00 $</td>
</tr>
<tr>
<td>Terre-Neuve-et-Labrador (n = 1)</td>
<td>142 000,00 $</td>
</tr>
<tr>
<td>Île-du-Prince-Édouard (n = 1)</td>
<td>24 000,00 $</td>
</tr>
</tbody>
</table>

Figure 11. Modes de rémunération.

<table>
<thead>
<tr>
<th>Mode de rémunération</th>
<th>% des répondants</th>
<th>Nombre de répondants (n = 138)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaire fixe</td>
<td>83,3 %</td>
<td>115</td>
</tr>
<tr>
<td>Salaire de base plus un pourcentage de vos revenus bruts ou des montants facturés</td>
<td>16,6 %</td>
<td>23</td>
</tr>
<tr>
<td>Revenu basé sur un pourcentage de vos revenus bruts</td>
<td>0 %</td>
<td>0</td>
</tr>
</tbody>
</table>

Figure 12. Dette étudiante moyenne à la fin du cours ($CAN) selon la faculté de médecine vétérinaire et la promotion.
(n = nombre de répondants par faculté).

<table>
<thead>
<tr>
<th>College</th>
<th>Dette 2016</th>
<th>Dette 2015</th>
<th>Dette 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVC</td>
<td>91 590 n = 18</td>
<td>101 454 n = 11</td>
<td>140 421 n = 19</td>
</tr>
<tr>
<td>FMV</td>
<td>32 930 n = 28</td>
<td>19 687 n = 24</td>
<td>31 220 n = 25</td>
</tr>
<tr>
<td>OVC</td>
<td>54 950 n = 39</td>
<td>43 184 n = 33</td>
<td>55 133 n = 30</td>
</tr>
<tr>
<td>UCVM</td>
<td>70 550 n = 8</td>
<td>74 083 n = 12</td>
<td>51 446 n = 13</td>
</tr>
<tr>
<td>WCVM</td>
<td>50 190 n = 42</td>
<td>47 111 n = 27</td>
<td>50 500 n = 26</td>
</tr>
</tbody>
</table>
**Figure 13.** Avantages professionnels offerts en plus du salaire de base.

<table>
<thead>
<tr>
<th>Avantages</th>
<th>% des répondants</th>
<th>Nombre de répondants (n = 133)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primes pour le travail sur appel ou en dehors des heures normales</td>
<td>42,8 %</td>
<td>57</td>
</tr>
<tr>
<td>Téléphone cellulaire</td>
<td>27 %</td>
<td>36</td>
</tr>
<tr>
<td>Allocation vestimentaire</td>
<td>44,4 %</td>
<td>59</td>
</tr>
<tr>
<td>Frais de formation continue</td>
<td>79,7 %</td>
<td>106</td>
</tr>
<tr>
<td>Dépenses pour les déplacements liés à la formation continue</td>
<td>42,8 %</td>
<td>57</td>
</tr>
<tr>
<td>Assurance invalidité</td>
<td>24 %</td>
<td>32</td>
</tr>
<tr>
<td>Assurance dentaire</td>
<td>52,6 %</td>
<td>70</td>
</tr>
<tr>
<td>Assurance santé</td>
<td>60,2 %</td>
<td>80</td>
</tr>
<tr>
<td>Assurance vie</td>
<td>25,6 %</td>
<td>34</td>
</tr>
<tr>
<td>Assurance pour faute professionnelle</td>
<td>66,9 %</td>
<td>89</td>
</tr>
<tr>
<td>Paiement des frais de permis</td>
<td>81,2 %</td>
<td>108</td>
</tr>
<tr>
<td>Paiement de la cotisation d’une association professionnelle à adhésion volontaire</td>
<td>38,3 %</td>
<td>51</td>
</tr>
<tr>
<td>Fonds de retraite</td>
<td>8,3 %</td>
<td>11</td>
</tr>
<tr>
<td>Partage des profits</td>
<td>3 %</td>
<td>4</td>
</tr>
<tr>
<td>Rétention</td>
<td>0,8 %</td>
<td>1</td>
</tr>
<tr>
<td>Congé de maladie ou pour des raisons personnelles</td>
<td>36,1 %</td>
<td>48</td>
</tr>
<tr>
<td>Allocation pour un véhicule ou dépenses pour le transport</td>
<td>24,8 %</td>
<td>33</td>
</tr>
<tr>
<td>Autre (veuillez préciser) repas assurance maladie pour animaux</td>
<td>3 %</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Avantages</th>
<th>% des répondants</th>
<th>Nombre de répondants (n = 133)</th>
</tr>
</thead>
<tbody>
<tr>
<td>After-hours/on-call premiums</td>
<td>42.8%</td>
<td>57</td>
</tr>
<tr>
<td>Cell phone</td>
<td>27%</td>
<td>36</td>
</tr>
<tr>
<td>Clothing allowance</td>
<td>44.4%</td>
<td>59</td>
</tr>
<tr>
<td>Continuing education fees</td>
<td>79.7%</td>
<td>106</td>
</tr>
<tr>
<td>Continuing education travel expenses</td>
<td>42.8%</td>
<td>57</td>
</tr>
<tr>
<td>Disability insurance</td>
<td>24%</td>
<td>32</td>
</tr>
<tr>
<td>Dental insurance</td>
<td>52.6%</td>
<td>70</td>
</tr>
<tr>
<td>Health insurance</td>
<td>60.2%</td>
<td>80</td>
</tr>
<tr>
<td>Life insurance</td>
<td>25.6%</td>
<td>34</td>
</tr>
<tr>
<td>Malpractice insurance</td>
<td>66.9%</td>
<td>89</td>
</tr>
<tr>
<td>Payment of licensing fees</td>
<td>81.2%</td>
<td>108</td>
</tr>
<tr>
<td>Payment of fees for voluntary professional association membership</td>
<td>38.3%</td>
<td>51</td>
</tr>
<tr>
<td>Pension</td>
<td>8.3%</td>
<td>11</td>
</tr>
<tr>
<td>Profit sharing</td>
<td>3%</td>
<td>4</td>
</tr>
<tr>
<td>Retention</td>
<td>0.8%</td>
<td>1</td>
</tr>
<tr>
<td>Sick leave/compassionate leave</td>
<td>36.1%</td>
<td>48</td>
</tr>
<tr>
<td>Vehicle allowance/transportation expenses</td>
<td>24.8%</td>
<td>33</td>
</tr>
<tr>
<td>Other (please specify) meal allowances/pet insurance</td>
<td>3%</td>
<td>4</td>
</tr>
</tbody>
</table>
Other information

Figure 14. Number of graduates who are currently members of professional organizations other than their provincial regulatory body (n = 132).

<table>
<thead>
<tr>
<th>Organization</th>
<th>Number of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Animal Hospital Association (AAHA)</td>
<td>22</td>
</tr>
<tr>
<td>Association des médecins vétérinaires du Québec</td>
<td>10</td>
</tr>
<tr>
<td>Canadian Veterinary Medical Association (CVMA)</td>
<td>113</td>
</tr>
<tr>
<td>Ontario Veterinary Medical Association (OVMA)</td>
<td>36</td>
</tr>
<tr>
<td>None</td>
<td>7</td>
</tr>
<tr>
<td>Other</td>
<td>25</td>
</tr>
</tbody>
</table>

Other organizations:
- Association of Veterinary Anaesthetists (AVA) n = 1
- American Association of Equine Practitioners (AAEP) n = 8
- American Association of Bovine Practitioners (AABP) n = 4
- Canadian Association of Bovine Veterinarians (CABV) n = 2
- Atlantic Bovine Practitioners Association (ABPA) n = 1
- Ontario Association of Bovine Practitioners (OABP) n = 2
- Ontario Association of Swine Veterinarians (OASV) n = 1
- American Association of Swine Veterinarians (AASV) n = 2
- American Veterinary Medical Association (AVMA) n = 3
- Western Canadian Association of Bovine Practitioners (WCABP) n = 1
- Association Vétérinaire Québécoise de Médecine de refuge (AVQMR) n = 1
- Ontario Association of Poultry Practitioners (OAPP) n = 1
- American Holistic Veterinary Medical Association (AHVMA) n = 1
- Association des médecins vétérinaires praticiens du Québec (AMVPQ) n = 1

Respondents indicated the top 3 challenges they faced (n = 130); the following challenges were among the most frequently mentioned (listed in order of prevalence):
- Lack of confidence
- Schedule that is overloaded or difficult to manage
- Work-life balance
- Communication with clients or difficult clients
- Lack of experience

The 2016 New Graduate Survey Report was written by Mélissa Gohier from the Faculté de médecine vétérinaire (FMV).

Autres renseignements

Figure 14. Nombre de diplômés qui sont actuellement membres d'organisations professionnelles autres que leur organisme de réglementation provincial (n = 132).

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Nombre de répondants</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Animal Hospital Association (AAHA)</td>
<td>22</td>
</tr>
<tr>
<td>Association des médecins vétérinaires du Québec</td>
<td>10</td>
</tr>
<tr>
<td>Association canadienne des médecins vétérinaires (ACMV)</td>
<td>113</td>
</tr>
<tr>
<td>Ontario Veterinary Medical Association (OVMA)</td>
<td>36</td>
</tr>
<tr>
<td>Aucune</td>
<td>7</td>
</tr>
<tr>
<td>Autre</td>
<td>25</td>
</tr>
</tbody>
</table>

Autres organisations :
- Association of Veterinary Anaesthetists (AVA) n = 1
- American Association of Equine Practitioners (AAEP) n = 8
- American Association of Bovine Practitioners (AABP) n = 4
- Association canadienne des vétérinaires bovins (CABV) n = 2
- Atlantic Bovine Practitioners Association (ABPA) n = 1
- Ontario Association of Bovine Practitioners (OABP) n = 2
- Ontario Association of Swine Veterinarians (OASV) n = 1
- American Association of Swine Veterinarians (AASV) n = 2
- American Veterinary Medical Association (AVMA) n = 3
- Western Canadian Association of Bovine Practitioners (WCABP) n = 1
- Association vétérinaire québécoise de médecine de refuge (AVQMR) n = 1
- Ontario Association of Poultry Practitioners (OAPP) n = 1
- American Holistic Veterinary Medical Association (AHVMA) n = 1
- Association des médecins vétérinaires praticiens du Québec (AMVPQ) n = 1

Les répondants ont indiqué les trois principaux défis auxquels ils ont dû faire face (n = 130); les défis suivants étaient ceux qui étaient le plus fréquemment mentionnés (indiqués en ordre de prévalence):
- Manque de confiance
- Horaire surchargé ou difficile à gérer
- Équilibre travail-vie
- Communication avec les clients ou les clients difficiles
- Manque d’expérience

Le Rapport sur le sondage auprès des finissants 2016 a été rédigé par Mélissa Gohier de la Faculté de médecine vétérinaire (FMV) de l’Université de Montréal.
2017 CVMA Convention Charlottetown, July 13–16
Unleash Your Potential!

The 2017 CVMA Convention is less than 2 months away, but you can still take advantage of the early bird savings up until June 2. The Convention, July 13–16, offers over 128 RACE-approved continuing education (CE) credits so you can earn up to 27 credits. Top-notch speakers from Canada and the United States have been invited to speak. Here’s a few who you don’t want to miss.

Dr. Alex Reiter, a diplomate of the American and European Veterinary Dental Colleges, will give 6 dentistry lectures. He will look at perioperative considerations relating to patient management prior to, during, and after anesthesia. He will review the diagnosis and treatment of stomatitis in cats, focusing on therapeutic strategies that work. Further, he will provide information about closed and open tooth extraction, as well as management of extraction complications. Dr. Reiter will also discuss the diagnosis and treatment of maxillary and mandibular fractures and adjacent soft-tissue injuries and discuss the most commonly recognized oral tumors, and staging of the dogs and cats with

Le congrès 2017 de l’ACMV
Charlottetown, du 13 au 16 juillet
Libérez votre potentiel!


Le Dr’ Alex Reiter, diplomate des Collèges dentaires vétérinaires américain et européen, donnera six conférences sur la dentisterie. Il se penchera sur les considérations péri-opératoires se rapportant à la gestion du patient avant, durant et après l’anesthésie. Il passera en revue le diagnostic et le traitement de la stomatite chez les chats, en se concentrant sur les stratégies thérapeutiques efficaces. De plus, il fournira des renseignements à propos de l’extraction de dents ouverte et fermée ainsi que de la gestion des complications liées à l’extraction. Le Dr’ Reiter discutera aussi du diagnostic et du traitement des fractures maxillaires et mandibulaires et des blessures des tissus mous adjacents et il parlera des tumeurs orales les plus fréquemment reconnues ainsi que des stades des tumeurs orales chez les chiens et les chats. Le dernier atelier se penchera sur les efforts de reconstruction pour les patients durant le traitement de lésions orales congénitales, traumatiques ou néoplasiques.

Le Dr’ Alastair Cribb, professeur de pharmacologie clinique à la Faculté de médecine vétérinaire de l’Université de Calgary, examinera la compréhension actuelle de la pharmacologie clinique des anti-inflammatoires non stéroïdiens (AINS) et des médicaments connexes. Il communiquera les progrès récents au niveau de la biologie des cyclooxygénases et des prostaglandines et il abordera aussi la
oral tumors. The final session will look at reconstructive efforts made for patients during treatment of congenital, traumatic or neoplastic oral lesions.

**Dr. Alastair Cribb**, professor, Clinical Pharmacology, University of Calgary Faculty of Veterinary Medicine, will review the current understanding of the clinical pharmacology of nonsteroidal anti-inflammatory drugs (NSAIDs) and associated drugs. He will share important recent advances in the biology of cyclooxygenases and prostaglandins and the pharmacodynamics and pharmacokinetics of NSAIDs relevant to their clinical use in companion animals will be addressed. He will also review the current evidence for the use and selection of NSAIDs in companion animals, covering both efficacy and adverse effects. The session will address important differences between NSAIDs that may aid the clinician in making rational decisions for an individual patient. And in a 3rd session, he will provide an introductory look at personalized and precision medicine in companion animal practice.

**Drs. Sandra McConkey and Hans Gelens**, both with the Atlantic Veterinary College, will look at the insightful use of antibiotics that is required in today’s world of increasing antimicrobial resistance. Their talks will discuss the rational use of antibiotics in small animal patients using an interactive clinical case-based format.

Dermatology sessions will be given by **Dr. Karri Beck** who works out of 2 referral hospitals in the greater Toronto area. She will look at a variety of immune-mediated skin diseases that are seen so infrequently in general practice that they are often overlooked. Treatment of immune-mediated skin disease often involves the use of immunosuppressive medications such as steroids, azathioprine, chlorambucil and cyclosporine. A 2nd session will focus on recognizing the various reaction patterns and potential differentials, diagnostic work-up and treatment options for allergic feline patients. Canine atopic dermatitis will be presented with various treatment options.

These are just a few of the speakers in the 2017 CVMA Convention program. And the CVMA Convention isn’t just about CE sessions. Opportunities to network and reconnect with colleagues abound as well as an exciting Exhibit Hall showcasing new products and services. The Atlantic Veterinary College is holding a reunion for its alumni on Friday, July 14 at
To All Members of the Canadian Veterinary Medical Association (CVMA)

Notice of the Annual General Meeting of the CVMA

All members of the CVMA are invited to participate in the Annual General Meeting (AGM), taking place in the Harbourview Rooms at the PEI Convention Centre (18 Queen Street) in Charlottetown, PEI on Thursday, July 13 from 12:00 am to 2:30 pm, during the 2017 CVMA Convention. Immediately following the AGM, the CVMA will hold its annual Awards Ceremony.

Note:
Although all CVMA members have access to theater seating at the AGM, only those with a meal ticket can be provided with a lunch. To obtain a meal ticket, please go to our online convention registration site (www.canadianveterinarians.net/science-knowledge/annual-convention-registration) and sign up for the AGM.

À tous les membres de l'Association canadienne des médecins vétérinaires (ACMV)

Avis de l'Assemblée générale annuelle de l'ACMV

Tous les membres de l'ACMV sont invités à participer à l'Assemblée générale annuelle (AGA) qui aura lieu le jeudi 13 juillet de 12 h à 14 h 30 dans les salles Harbourview du PEI Convention Centre (18 rue Queen) à Charlottetown (I.-P.-É.), durant le congrès 2017 de l'ACMV. Immédiatement après l'AGA, l'ACMV tiendra sa cérémonie annuelle de remise des prix.

Nota :
Même si tous les membres de l'ACMV ont accès à des sièges dans l'amphithéâtre à l'AGA, un repas sera servi uniquement aux personnes qui ont obtenu un billet de repas à l'avance. Pour obtenir un billet de repas, veuillez vous rendre au site d'inscription en ligne au congrès (www.veterinairesaucanada.net/science-knowledge/annual-convention-registration) et inscrivez-vous à l'AGA.
Special Report  Rapport spécial

Lessons learned from the evolution of terrestrial animal health surveillance in Canada and options for creating a new collaborative national structure

V. Wayne Lees, Cameron Prince

Introduction

Canada has a long history of strong terrestrial animal health surveillance and disease control programs based upon officially designated, federally reportable, and notifiable diseases (1). These diseases pose a major threat to animal health, human health, and our trade in food animal products. In a large country with diverse ecological and production systems, it is a challenge to create a collaborative approach to the rapid identification, characterization, and response to new and emerging diseases or to production-limiting diseases that are not currently listed in federal regulations.

Designing a formal, coordinated, national surveillance system for these diseases has been the subject of a great deal of effort over the last 35 years. The Canadian Food Inspection Agency (CFIA), in collaboration with the Public Health Agency of Canada (PHAC) and 12 other partner organizations, recently led a project to develop and pilot test a system for the early warning of emerging and zoonotic diseases that may pose a threat to Canada. Known as the Centre for Emerging and Zoonotic Disease — Integrated Intelligence and Response (CEZD-IIR), the project was funded under the federal Canadian Safety and Security Program (CSSP), which supports initiatives to enhance the security of Canadians. Another initiative, the Canadian Animal Health Surveillance System (CAHSS), has been proposed to link the various existing surveillance networks across the country.

To determine how these initiatives best fit into the current animal health framework in Canada, it is important to first understand the evolution of previous efforts to create a national, collaborative surveillance system. This report documents the evolution of animal health surveillance in Canada between 1980 and 2015 and offers a comparative look at 3 international models. Recommendations are offered for consideration when designing future national animal health surveillance systems.

Why is an effective surveillance system important to Canada?

There are 2 major functions of any effective animal health surveillance system: i) to quickly identify any new or emerging disease before it spreads too far, so that it can be brought under control as soon as possible; and ii) to monitor diseases already present, to evaluate if Canada’s control measures are effective.

An effective surveillance system underpins our ability to: • trade in live animals and agricultural products internationally, • protect the public from zoonotic diseases and related food-borne illnesses, • improve animal welfare through timely disease control, and • protect the economic well-being of producers.

In recent years, Canada has experienced incursions of significant disease threats, including: bovine spongiform encephalopathy (BSE), West Nile virus, highly pathogenic avian influenza, H1N1 influenza in swine, porcine multi-systemic wasting syndrome, and porcine epidemic diarrhea. In addition, active ongoing control programs have been mounted against rabies, chronic wasting disease, and bovine tuberculosis affecting cattle and wild cervids.

An effective One Health approach to animal health surveillance is essential to protect farmed animals, wildlife and humans. This will require a new, more integrated approach to surveillance than we have seen in the past. It will not take the form of one massive system; rather, the technology is now in place to utilize a more distributed network of systems whereby data and collective wisdom are shared between animal and human health partners in government, industry, and academia. It is our opinion that the major stumbling block will be to establish an enduring collaborative model for funding and governing the system — one that can persist despite changing priorities and issues of the day. Our past experience gives us the foundation upon which to build a truly collaborative, national terrestrial animal health system.

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The views expressed are those of the authors, based on their personal experiences in the Canadian animal health system. Wayne Lees has worked in veterinary practice and in the Surveillance Unit of the CFIA. He recently retired as Chief Veterinary Officer for Manitoba. Cam Prince has over 35 years of experience in the management and delivery of food safety and quality inspection and audit systems. He was formerly Vice President of Operations and Inspection Modernization at the CFIA.

Although this article is being published as a Special Report, it has been peer-reviewed.

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The evolution of animal health surveillance

Canada has an extensive, well-trained cadre of private veterinary practitioners, a very good diagnostic veterinary laboratory system, and well-developed animal health institutions at the federal, provincial, territorial, and academic levels. These systems perform very well for monitoring animal diseases that have already been identified and for which disease control programs have been developed. Canada’s efforts to eradicate bovine tuberculosis and brucellosis are perhaps the best examples of strong federally led programs that were carried out for more than half a century, for the benefit of animal health and human health alike. However, as these programs achieved their goals, the Canadian Food Inspection Agency (formerly the Health of Animals Branch, Agriculture Canada) scaled back on its on-farm presence, and the 3-way direct contact between farmer, veterinary practitioner, and regulator was weakened. This trend has continued with further program adjustments at the federal level, with the result that the informal ‘over the fence’ conversations that used to alert officials to new or unusual diseases no longer took place.

The establishment of a coordinated, comprehensive national approach to animal health surveillance for emerging diseases has been in development for many decades in Canada. This paper provides an overview of the various organizations, committees, and councils that have been or continue to be part of the process. As we look to the future, it is important to understand the efforts that have gone before.

Canadian Animal Health Consultative Committee

During the 1980s, the federal government was the lead agency for animal health disease surveillance and control in Canada. Most of the provinces had a provincial veterinarian, but his/her role in managing animal health programs was not as active as that of today’s provincial and territorial Chief Veterinary Officers. Many of the provincial veterinarians were pathologists and directors of their provincial veterinary diagnostic laboratories. As such, they played a valuable role in identifying new or emerging diseases found in diagnostic specimens delivered to the laboratory. These case reports were often shared through newsletters, teleconferences, or diagnostic pathology conferences but there was no formalized alert mechanism for national information dissemination.

To improve national dialogue on the direction of the national animal health programs, in the 1970s the Health of Animals Branch of Agriculture Canada (which is now part of the CFIA) established the Canadian Animal Health Consultative Committee (CAHCC), which held an annual open meeting of the major stakeholders in Canada (2). Akin to the annual meeting of the US Animal Health Association, it included representatives from federal, provincial, and territorial animal diagnostic laboratories and disease control programs, academics, veterinary associations, producer associations, public health representatives, and international observers. Over the course of the 2- to 3-day annual meeting, updates were given on all of the major federal disease control and food inspection programs and proposals.

This was a first attempt to provide a national forum for major stakeholders to comment on disease control efforts and to share animal disease information. However, because it was an annual forum, it lacked the immediacy needed when dealing with new or emerging diseases. The CAHCC annual conference was discontinued in 2005 and was replaced in 2011 by the National Farmed Animal Health and Welfare Council (NFAHWC) Annual Forum.

Canadian Animal Health Coalition (CAHC)

The highly structured format of the CAHCC annual meeting and packed agenda offered limited ability for in-depth comment and further analysis. To overcome this, in 2002 a number of the major producer groups and some provinces formed the Canadian Animal Health Coalition to create a stronger voice in influencing the direction of animal health programs. The Coalition has since evolved into an association of industry groups who have managed a number of important projects to advance Canada’s animal health system. These include: studies on the economic impact of foot-and-mouth disease; a pilot project on zoning at West Hawk Lake on the Manitoba-Ontario border; models for the control of Johne’s disease; coordination of emergency management systems among governments and producer groups; contributions toward the development of animal welfare codes of practice (3).

Canadian Animal Health Network (CAHNet)

In 1996, an Animal Disease Symposium brought together over 100 participants from federal and provincial governments, veterinary colleges, private practice, and producer organizations to forge a new alliance for animal disease surveillance in Canada, the Canadian Animal Health Network or CAHNet (4). This network was led by the Animal Diseases Surveillance Unit at the CFIA and was charged with coordinating a response to diseases that fell outside the traditional federal mandate.

The Canadian Animal Health Network was to be an information broker for new and emerging diseases in Canada, to support both animal health and public health objectives. The network sponsored monthly national teleconferences with provincial chief veterinarians and veterinary laboratories, and published a semi-annual bulletin that highlighted new and ongoing animal health issues (5). Though still largely an informal approach, CAHNet did facilitate important and timely national discussions about newly emerging diseases, such as West Nile Virus incursions across the country, and the spread of post-weaning multi-systemic weaning syndrome (PMWS) in swine. With the reallocation of staff and resources, CAHNet was disbanded after operating for 6 years.

Canadian Animal Health Surveillance Network (CAHSN)

Initiated in 2004 and originally funded as a 4-year project sponsored by Defence Research and Development Canada (now the Centre for Security Sciences), the Canadian Animal Health Surveillance Network (CAHSN) included partners in federal and provincial animal health departments and diagnostic laboratories, the Public Health Agency of Canada, university animal
health diagnostic laboratories, and the Canadian Cooperative Wildlife Health Centre (now known as the Canadian Wildlife Health Cooperative), the university-based network of wildlife diagnostic pathologists and epidemiologists (6).

CAHSN’s goals were to:
- Establish a network of animal health diagnostic laboratories (federal, provincial, and academic) that would enhance Canada’s diagnostic surge capacity for testing for foreign animal diseases;
- Establish a framework for combining disease intelligence from across Canada to detect emerging disease threats;
- Coordinate disease response in a timely manner; and
- Support these goals through a common information technology platform based on the Canadian Network for Public Health Intelligence (CNPHI) architecture.

The Canadian Animal Health Surveillance Network did achieve some very important accomplishments during its 4 years of active development. The network of veterinary diagnostic laboratories across the country was significantly strengthened as facilities and equipment were upgraded, common diagnostic protocols were established, and staff training was supported. The link between federal, provincial, and academic diagnostic laboratories was further enhanced when data sharing agreements and a common data platform were put in place.

However, the original concept of having CAHSN act as the unifying national (as opposed to simply federal) diagnostic, and epidemiological umbrella organization that would collect, collate, and analyze surveillance data from across Canada and create early warning intelligence was never fully realized. The project funding ended just as the surveillance piece was coming to the fore. Efforts to create an ongoing, self-sustaining, not-for-profit style governance structure did not gain widespread financial constraints. In the end, the CFIA agreed to sponsor a minimalist approach to CAHSN, maintaining the laboratory network component, especially as it related to supporting diagnostic and surveillance capacity for federally named diseases of interest. A significant legacy of CAHSN was to raise awareness of the need for a national collaborative surveillance network that could coordinate response to new or emerging diseases among the multiple tiers of the animal health infrastructure.

Canadian Regulatory Veterinary Epidemiology Network (CRVE-Net)
The Canadian Regulatory Veterinary Epidemiology Network (CRVE-Net) is based at the Atlantic Veterinary College in Charlottetown, PEI. Established in 2009, the CFIA has contributed funding “to support the continuation of CRVE-Net’s work in linking Canada’s 5 veterinary colleges to develop expertise in veterinary epidemiology risk analysis, surveillance, modelling, and modern tools to enhance knowledge to address terrestrial and aquatic animal diseases of importance to Canada.” (7). This was a significant first step to create a formal partnership between the veterinary colleges and the CFIA involving research into diseases of regulatory interest.

National Farmed Animal Health and Welfare Council (NFAHWC)
About the same time that CAHSN was in development, there were attempts to develop an overarching animal health strategy for Canada. The Council of Chief Veterinary Officers (CCVO), comprising federal/provincial/territorial (FPT) Chief Veterinary Officers, began to take a much more active role in this process. With support from FPT assistant deputy ministers (ADMs) of agriculture, the CCVO partnered with the major livestock and poultry commodity organizations to create the initial National Farmed Animal Health and Welfare Council (NFAHWC). The Council was to be an advisory body reporting to the FPT ADMs on major issues of animal health and welfare policy and strategic direction. In a similar fashion, the Council’s livestock and poultry industry representatives were to report to the commodity organizations. Rounding out participation in the Council were representatives from the Council of Chief Medical Officers of Health, the Public Health Agency of Canada and academia.

Since its inception in 2010, the Council has played a significant role in promoting strategic thinking in animal health and welfare. One of its early reports, “Surveillance in a time of transition in farmed animal health,” articulated a number of observations and recommendations to improve the nation’s animal health surveillance system (8). The report identified problems with the current surveillance system in terms of a lack of leadership and coordination, which led to the inability to easily detect trends or emerging diseases. There was also a lack of understanding among stakeholders about the value of surveillance. Recommendations were proposed under 2 major headings: leadership and organization, and technical enhancements. A national collaborative corporate structure was proposed that would coordinate the surveillance systems across the country under a board of directors who were overseen by the CCVO. Technical enhancements were proposed that would strengthen CAHSN’s role in data management and analysis for known and emerging diseases of animal health or veterinary public health significance.

In 2012, the Council published a progress report on Canada’s capabilities in anticipation and agri-intelligence (9). The report noted that although stakeholders received a large amount of animal health information, very little of it was in the form of agri-intelligence. Those surveyed agreed that agri-intelligence could proactively identify opportunities and avoid or reduce the impact of adverse events, but that the intelligence had to be customized for various users. The Council encouraged further development of the agri-intelligence capacity of the federal government and encouraged industry and provincial/territorial stakeholders to participate in the development of this capacity. The report also noted that the industry-led initiative to monitor health of swine across Canada through the Canadian Swine Health Intelligence Network (CSHN) was a significant development that employed novel techniques using social media to gather disease information directly from producers and veterinary practitioners. This information was analyzed and distributed to the members, and was recognized as an innovative early warning system for swine diseases.
The NFAHWC has continued to advance the notion of a national animal health surveillance system as part of a national animal health system. Surveillance and intelligence systems go hand in hand, with each providing the other with continuous feedback. At the 2014 NFAHWC Annual Forum (10), a number of initiatives were reported to be proceeding simultaneously, including:

- Work is continuing on development of a disease prioritization and categorization tool that will help clarify what new or emerging diseases should command CFIA involvement.
- The CEZD-IIR project is developing tools to generate animal health intelligence from open source information, with the view to bolster Canada’s capacity to identify early warning signals for emerging diseases.
- Work is proceeding to develop a sustainable model of governance for the overarching “network of networks,” which has been described as a loosely affiliated distributed system of networks that are based on key principles, rather than one that is centrally controlled. This initiative since evolved into the Canadian Animal Health Surveillance System (CAHSS) which is further discussed below.

Although it does not presently operate disease surveillance and control programs itself, the National Farmed Animal Health and Welfare Council has emerged as an important organization for undertaking collaborative policy analysis and creating policy recommendations for industry and government organizations alike.

Canadian Animal Health Surveillance System (CAHSS)

The CAHSS is a network of networks, backed by the NFAHWC, which links many existing government and non-government animal health surveillance networks that have collectively and voluntarily agreed to collaborate (11). Each network is independently governed and self-funded, but is linked through CAHSS by a common vision to create an integrated animal health surveillance system in Canada. A Directors Group, drawn from the participants, establishes priorities and initiates activities, and is supported by a Champions Group, who provide strategic direction and higher level support. Several federal employees in CFIA and AAFC have been dedicated to provide operational support to CAHSS.

The approach taken by CAHSS is a significant step forward in the evolution of a national animal health surveillance system. By recognizing the diversity of existing networks and by working towards achieving common goals, this approach is most likely to succeed in a country such as Canada. Creating these synergies, the interests of domestic animal, wildlife, and public health officials, producer groups, and academia can be served collectively through a One Health methodology.

The next logical step in this process will be to create a governance and funding model that is more permanent and stable. Excellent progress has been made based on the goodwill of the participants, but as people and priorities change over time, CAHSS support is vulnerable to the shifting focus of the issue of the day. This can put at risk the long-term viability of this type of voluntary system.

Provincial Animal Health Surveillance Networks

In the past, the heart of most provincial animal health surveillance systems centered on the veterinary diagnostic laboratories. This network of laboratories served as a very good early warning system to the presence of a new disease, but they did not have a formal way of amassing clinical data from the field to measure its impact. Various provinces have developed their own surveillance networks, but the provincial resources available to conduct surveillance vary greatly across the country. Perhaps the most well-developed system is Quebec’s RAIZO network (12), which links producers, practitioners, veterinary diagnostic laboratories, and disease investigation specialists. Other provinces, such as Ontario and Alberta, have developed surveillance networks for some species, but structure, function, and capacity in this area differ significantly from province to province.

Public Health Network

The pan-Canadian Public Health Network (PHN) was established following the Severe Acute Respiratory Syndrome (SARS) outbreak in 2005 to develop policy advice and collaborative infrastructure to address important public health threats. It comprises the FPT Chief Public Health Officers, senior government officials, academics, health professionals, and non-government organizations. It is governed by a 17-member Council that provides advice to the FPT Deputy Ministers of Health. Steering committees provide operational coordination among the jurisdictions in 3 key areas: Healthy People and Communities; Communicable and Infectious Disease; and Public Health Infrastructure (13).

While this structure works well for human health surveillance, especially for monitoring the annual outbreaks of human influenza through its FluWatch network (14), the organizational differences between human health and animal health are significant. There are no equivalents in human health to the animal industry stakeholders, such as the food animal and poultry producer associations. To be effective, any animal health surveillance system must include these organizations as primary partners.

International models

There are several international models of animal health systems worth examining to see if they hold value in a Canadian context. Each has a different approach to governance, ranging from primarily industry-led to primarily government-led, and something in between — a collaborative industry-government approach. Here are some examples of different models that could be considered.

Animal Health Ireland

Animal Health Ireland is an industry-led, not-for-profit partnership (15). Its purpose is to develop control programs for endemic production-limiting diseases, such as bovine viral diarrhea and mastitis. Government does play an advisory role, but the organization is funded and operated mainly by industry.

This structure works well for diseases that are well-recognized, endemic, and have their primary impact on economic production. As the programs are led by farmers with advice from
government, they are more likely to be implemented in the field. However, this system has limitations in dealing with new or emerging diseases that may require a rapid, non-voluntary, regulatory response.

The Animal Health and Welfare Board of England
Members of this Board are nominated by industry but appointed by the English government (16). The Board reports directly to the Ministers on strategic advice related to animal health and welfare, and has a role in monitoring the regulatory framework. The Board is primarily advisory in nature, and does not operate disease surveillance or control programs itself.

The primary advantage of this system is the direct access to senior levels of government. To some, this may appear to be attractive at first glance, but in our context it would tend to subvert the established policy-making framework. Canada’s system of vetting policy proposals through producer groups and the civil service does provide a great deal of opportunity for consultation and refinement. Finding a system that is responsive and yet inclusive should be our goal.

Animal Health Australia
Animal Health Australia (AHA) is an interesting model that may hold value for Canada, as it seeks to balance federal, state, and industry interests. Funded equally by federal and state governments, and industry partners, this independent not-for-profit company operates over 50 animal health programs for a number of species (17). Its priorities are to: manage and strengthen the emergency management system; enhance preparedness and response capacity among stakeholders; strengthen biosecurity and animal welfare; and deliver value to its members. Animal Health Australia has developed strategies for enhancing biosecurity and animal welfare, the AusVetPlan emergency response manuals, biosecurity manuals, and created a disease alert system.

What is attractive about this model is its inclusiveness. Because it includes both layers of governments and producer groups, this model might work well for Canada’s diverse agricultural sectors. Its tripartite funding model as a not-for-profit corporation means that it is not controlled by any one entity; therefore, collaborative solutions must be found. In addition to policy advice, AHA manages a truly impressive suite of programs ranging from controlling indigenous diseases to designing biosecurity measures and to creating emergency management plans.

Canada has taken a step in this direction with the creation of the National Farmed Animal Health and Welfare Council. It uses a similar funding approach and includes a wide variety of expertise on its board. However the Council has been limited thus far to a policy advisory role. If the Animal Health Australia model holds value, the next logical step would be to create a not-for-profit corporate entity, and venture into the realm of program design and implementation, perhaps beginning with surveillance. The CAHSS model is a step in this direction, but it currently lacks the independent funding and corporate governance structure seen in the Animal Health Australia model.

Implications for future surveillance efforts
Canada’s animal production systems are diverse and regionally based, so it is not surprising that the animal health systems (including surveillance systems) that have evolved reflect that diversity. Some of these are based on geographic region (e.g., provincial boundaries); others are more national in scope but focus only on one species. Because animal health systems are structured and funded in a way that is significantly different from those in public health, it has been difficult, if not impossible, to design a one-size-fits-all surveillance and intelligence-gathering system for the entire country. It is clear that a new, collaborative model must be developed.

It is within this context and evolution that initiatives, such as CEZD-IIR and CAHSS, must be considered. CEZD-IIR will add intelligence analysis and early warning alert capacity to the Canadian animal health system. This capacity may exist in other systems for some species, for some provinces, or even in the personal networks of some experienced individuals, but there is no overarching intelligence gathering and analysis capacity that currently exists in Canada. The Canadian Animal Health Surveillance System shows promise for linking the networks, tools, and capabilities that currently exist, but to be useful it must serve the needs of its primary clients — animal and human health experts in governments, academic institutions, and animal producers. As it develops further, the next step should be to create an operational and independently funded program under the National Farmed Animal Health and Welfare Council. This would be a positive move towards developing a more formal, collaborative, integrated surveillance system.

Lessons for the future
Whatever national animal health structure is adopted, there are a number of lessons that can be learned from previous efforts to build surveillance and intelligence-gathering capacity in Canada. These are the first principles upon which any future national animal health system must be based.

Build strength from diversity
The diversity of animal health systems should be viewed as a strength rather than a weakness. Resilience is built through diversity — if one system fails, another steps in. For example, an early warning signal that may be missed by a provincially based system may be picked up by a species-based one. Therefore, any future early warning system must cast its net widely and build on the capacity of the other systems that are already in place.

Collaboration is key
There are simply too many diverse systems of agriculture in Canada to impose a one-size-fits-all approach to animal health and surveillance programs. There are also marked regional and sectoral differences in the capacity to fund and implement animal health programs. Balancing these interests requires a truly collaborative approach to finding outcome-based solutions. A recent report on the small-scale food production and processing sector in Manitoba used such a collaborative approach to focus
on identifying and achieving common outcomes that would benefit all (18). One recommendation from that report was to create a common organizational structure where all interests could be represented. Our NFAHW Council is the beginning of such an organization for animal health and welfare in Canada, but its role could be expanded to actually operate programs.

**Personal networks remain important**

Because Canada’s animal health regulatory and surveillance community is relatively small, the informal networks that have been developed have been quite effective at detecting new or emerging issues as long as there has been some way to share that information, such as via a teleconference. Regular teleconferences among the key players have been a central component of all of the surveillance systems that have evolved over the last 3 decades. Efforts to formalize, codify, and summarize this information in a report are useful as an adjunct, but they do not replace these essential personal contact networks.

**National coordination requires dedicated personnel and financial resources over a longer term**

In the past, effective networks have functioned on the basis of goodwill, but the commitment of the partners dwindles when resources become tight. To move beyond this requires a significant investment in dedicated human and financial resources. The CAHSN laboratory network was successful at improving the national surge capacity for diagnosing foreign animal diseases, but it required a sizeable commitment of federal funds for laboratory improvements along with the provincial commitment to upgrade training and certification. When the federal funding ended, some provinces struggled to meet their ongoing costs. It appears that a 3- or 4-year window of funding may not be sufficient to develop and establish a new system. Stable, long-term funding is necessary to support any national network.

**Technical issues are hurdles that can be overcome**

The diversity of surveillance systems across Canada creates technical hurdles for epidemiologists who must collate and analyze data in order to monitor disease trends across regions and across species. There has been some progress in standardizing information systems, but this has been slow. These problems may be difficult, but they are not insurmountable. For instance, with the advent of smart phone technologies, new opportunities arise for coupling real-time surveillance with in-depth analysis. Technological issues should not be seen as insurmountable — they are just speed bumps that slow advancement. Rather, it is the lack of leadership and vision that will completely derail progress.

**Success will depend on strong leadership from those with a vision**

Central to creating a national system is leadership. Without leadership from key individuals who carry a vision — and without the backing of strong champions who enable that process — there will simply be too many hurdles. The recent leadership of the NFAHW Council has brought together many partners under a common vision. This is an encouraging development, as building within this framework will ultimately strengthen all participants. Further expansion of the Council’s existing policy advisory role to include hands-on operational capacity will be critical to advancement.

**Conclusion**

“Those who cannot learn from history are doomed to repeat it.” This quote was first attributed to the Spanish philosopher George Santayana and was later immortalized by Sir Winston Churchill. As we seek to build an animal health framework for the future, let us not ignore the lessons from the past.

The framework for the future must be collaborative — a true stand-alone partnership between governments and industry, with stable funding and visionary leadership. We believe that the Animal Health Australia model holds the most promise for Canada. The NFAHW Council is an important first step in this direction, but its roles must be expanded, its funding secured, and its independence guaranteed.

**Acknowledgments**

This paper is based in part on the authors’ contribution to Part 1 of the report “CEZD-IIR Preliminary Sustainability Options,” prepared by TDV Global. We wish to thank James Dunlop of TDV Global and Harry Gardiner of the CFIA for their helpful suggestions.

**References**


Complications and risk factors of castration with primary wound closure: Retrospective study in 159 horses

Mickaël P. Robert, Ronan J.J. Chapuis, Claire de Fourmestraux, Olivier J. Geffroy

Abstract — Castration with primary wound closure reportedly has lower complication rates and shorter recovery periods compared to castration with second intention healing. However, little is known about risk factors associated with complications using primary wound closure. Medical records of 159 horses castrated and having primary wound closure were reviewed. Main short-term complications were: scrotal hematoma in 12 horses (7.6%), signs of colic in 6 horses (3.8%), fever in 4 horses (2.5%), and peri-incisional edema in 3 horses (1.9%). As for long-term complications, 24 out of 105 (23%) horses sustained some form of edema. One horse was euthanized because of a suspected inguinal abscess. Among tested parameters, horses aged 3 to 6 years old and French trotters appeared to be more at risk of developing complications. Intraoperative ligation of the cremaster muscle and use of electrocautery prevented complications. Overall, client satisfaction was excellent (98%).

Résumé — Complications et facteurs de risque de la castration avec fermeture des plaies par première intention : étude rétrospective chez 159 chevaux. La castration avec fermeture des plaies par première intention a un taux de complications plus faible et une période de convalescence plus courte que la castration avec cicatrisation par seconde intention. Cependant, on en sait peu sur les facteurs de risque associés aux complications en utilisant la technique de fermeture des plaies par première intention. Les dossiers médicaux de 159 chevaux castrés de cette façon ont été examinés. Les complications à court terme sont les suivantes: hématome scrotal chez 12 chevaux (7.6 %), signes de coliques chez 6 chevaux (3.8 %), fièvre chez 4 chevaux (2.5 %) et de l’œdème péri-incisioinal chez 3 chevaux (1.9 %). En ce qui concerne les complications à long terme, 24 sur 105 (23 %) chevaux ont présenté un certain degré d’œdème. Un cheval a été euthanasié à cause d’un probable abcès inguinal. Parmi les paramètres testés, les chevaux âgés de 3 à 6 ans et les Trotteurs Français semblent être plus à risque de développer des complications. En outre, la ligature peropératoire du muscle crémaster et l’utilisation du bistouri électrique semblent prévenir les complications. Dans l’ensemble, la satisfaction des clients était excellente (98 %).

Introduction

Castration is probably one of the oldest veterinary surgical procedures and the most frequently performed surgery in equine practice (1,2). Despite its routine character, more complications develop following castration than any other elective surgical procedure, some of them being life-threatening (3). It is also the most common cause of malpractice claim against equine surgeons in North America (4,5). Castration with primary wound closure under general anesthesia has been performed for more than 40 y (6). Lower complication rates and shorter recovery periods have been reported with this technique compared to those healing by second intention after scrotal incisions (3,7). However, little is known about the risk factors associated with complications and about the long-term follow-up of horses gelded using this technique.

The objectives of this retrospective study were to: i) report the short- and long-term complications in 159 horses castrated by a primary closure technique at the equine clinic of ONIRIS; ii) identify risk factors associated with these complications; iii) document overall client satisfaction regarding castration with primary closure.

Materials and methods

Medical records review

The records of all horses that were castrated using a primary closure technique under general anesthesia between January 2007 and June 2014 at the ONIRIS Nantes equine clinic were retrospectively reviewed. Intact males with 2 descended testes as
well as unilateral cryptorchid horses in which both testes could be retrieved via an inguinal approach were included. Horses in which a laparoscopic or a parainguinal cryptorchidectomy was performed were excluded. Collected data included signalment of the horse (breed, age), presence of cryptorchidism, perioperative treatments (type of antimicrobials and anti-inflammatory drugs received), experience of the surgeon (resident versus board-certified surgeon), and surgical technique (inguinal approach versus scrotal approach with scrotal ablation, use of electrocautery, ligation of the scrotal ligament, ligation of the cremaster muscle, emasculator applied to the cremaster muscle, ligation of the spermatic cord, type of emasculator used, size of suture material for spermatic cord ligation, twisting and attaching the vaginal tunic to the femoral fascia, closure of the superficial inguinal ring, technique of closure). Concurrent surgical procedures during the same anesthetic period were recorded, as well as complications and subsequent treatments. Hematoma and edema formation, signs of digestive pain or disturbance, and fever (> 38.8°C) occurring during hospitalization were all considered as short-term post-operative complications. In the authors’ hospital, peri-incisional seroma and edema smaller than a testis in size were considered acceptable and thus were not reported as complications. Moreover, catheter related complications and other postoperative abnormalities not related to the surgical procedure were not taken into account. Edema, weight loss, castration adhesions, hydrocele, and infection of the surgical site occurring after hospital discharge were all considered as long-term complications.

**Perioperative protocol**

Horses were fasted for 8 to 12 h before surgery and administered an antimicrobial drug. The anesthetic protocol included acetylcholine (Vetranquil; CEVA, Libourne, France), 0.02 mg/kg body weight (BW), IV or 0.04 mg/kg BW, IM, administered 20 to 60 min before sedation with romifidine (Sedivet; Boehringer-Ingelheim, Reims, France), 0.08 mg/kg BW, IV, and butorphanol (Torbugesic; Zoetis, Paris, France), 0.02 to 0.04 mg/kg BW, IV. Induction was performed with diazepam (Valium; Roche, Basel, Switzerland), 0.05 mg/kg BW, IV, and ketamine (Imalgene; Mérieux, Lyon, France), 2.2 mg/kg BW, IV. Horses were positioned in dorsal recumbency and anesthesia was maintained with isoflurane (Vetflurane; Virbac, Carros, France) in oxygen in a semiclosed circle system. After recovery, water was available as the horses were returned to their box stall, and food was gradually reintroduced according to auscultable gut motility, generally 4 to 6 h later.

Horses were generally discharged 48 h after surgery. Owners were asked to walk and trot their horse for 20 min for 10 d before resuming work.

**Follow-up**

Owners were contacted by telephone by 1 of the authors (R.J.J.C.) to determine whether complications occurred after discharge from the hospital and to grade their level of satisfaction regarding the surgery. A dedicated form specifically mentioning possible complications was used during this telephone interview.

**Statistical analysis**

Only horses with complete medical records were reviewed. Data were recorded and analyzed on Excel 2007. Descriptive statistics were used for relevant variables, in particular to report the incidence of short- and long-term complications. To determine risk factors associated with complications, Fisher’s exact test was used and odds ratio (OR) with 95% confidence intervals (CI) were calculated for each variable using BiostaTGV (http://marne.u707.jussieu.fr/biostatgv/?module=tests/fisher). Differences were considered significant at \( P < 0.05 \). Significant parameters were also tested for hematoma formation. For long-term complications, horses lost to follow-up were excluded from the analysis. In order to evaluate the incidence of general postoperative complications (colic and fever), a control group of horses that underwent elective surgical procedures at our hospital during the same study period was evaluated. Incidence of postoperative complications were compared with Fisher’s exact tests.

**Results**

During the study period, 159 horses aged 1 to 21 y old [mean ± standard deviation (SD) 4.2 y ± 2.6 y] were castrated using a primary closure technique under general anesthesia. There were 64 Selle Français, 23 German horses (Hanoverian, Holsteiner, Oldenburg), 12 Thoroughbreds, 9 French trotters, and 51 horses of 19 other breeds. Cryptorchidism was present in 40 horses (25%). Location of retained testis was inguinal in 25 horses and abdominal in 15 horses.

All horses received prophylactic antimicrobials. Penicillin (Depocillin; MSD, Beaucouzé, France) was given to 126 horses (79.2%), whereas a third (Excenel, Zoetis, Paris, France) or fourth generation (Cobactan, MSD, Beaucouzé, France) cephalosporin was given to 33 horses (20.8%). Six horses (3.8%) were given postoperative gentamicin (Forticine; Vétoquinol, Lure, France), either because of a concurrent surgical procedure, or because of a complication. All horses received either flunixin meglumine (Meflosyl; Zoetis), 1.1 mg/kg BW, IV, or phenylbutazone (Equipalazone; Dechra, Northwich, UK), 2.2 mg/kg BW, IV or PO, before and after surgery. All but 5 horses (97%) had postoperative anti-edema drugs consisting of a combination of dexamethasone, 0.01 to 0.02 mg/kg BW, IV or PO, and thiazide diuretic hydrochlorothiazide (Diurizonte, Vétoquinol), 2 to 3 mg/kg BW, IV or PO q24h for 4 d.

Regarding the surgical techniques used, 145 of 159 horses (91.2%), including those with retained testes, had an incision performed over each superficial inguinal ring. The remaining 14 horses had a scrotectomy that allowed access to both testes with 1 large incision. Electrocautery was used for skin incision and coagulation of small vessels in 47 horses (29.6%). After incising the inguinal fascia, the testis, covered by its vaginal tunic, was exteriorized. The cremaster muscle was isolated and ligated in 135 cases (84.9%) with either USP 1 or 2 polyglandin 910 and/or emasculated in 77 cases (48.4%). The parietal tunic was incised, allowing the testicle to be pulled out from the vaginal cavity. The ligament of the tail of the epididymis was sharply transected and the vaginal tunica separated from the mesorchium. All horses had...
their spermatic cord and vaginal tunic ligated during surgery to prevent hemorrhage and evisceration, respectively (3). Cord ligation was done with either USP 1 (13.4%) or USP 2 (86.6%) polyglactin 910. An emasculator was subsequently applied 2 cm distal to the ligature for 5 min. The vaginal tunic was transected and its stump closed either by a transfixation ligation (USP 1 or USP 2 polyglactin 910) or a simple continuous suture (2-0 absorbable suture material). On several occasions (40 horses), it was twisted twice and sutured to the femoral fascia. The superficial inguinal ring was closed in only 5 cases and exclusively in cryptorchid horses. Then, the inguinal fascia and the subcutaneous tissue were closed in 136 (85.5%) and 71 horses (44.6%) respectively. Finally, the skin was closed in a continuous pattern, either simple (72.4%) or intradermal (27.6%). Monofilament absorbable USP 2-0 suture material was generally used for the 3 latter layers. For retained testicles, the inguinal approach described by Schumacher (1) was successfully used in all cases.

Seventeen horses (10.7%) underwent another surgical procedure during the same anesthetic episode. Eight had an arthroscopy performed (1 to 4 joints), 2 had a prosthetic laryngoplasty, 2 had an umbilical herniorrhaphy, 2 had a platelet rich plasma copy performed (1 to 4 joints), 2 had a prosthetic laryngoplasty, and 2 had a prosthetic laryngoplasty. The effects of different variables on complications are reported in Table 2. Eleven horses (10.5%) required additional medical care, mainly diuretics and antimicrobials, because of persistent edema. Two horses underwent a second surgery, 1 because of scrotal adhesions and the other because of a hydrocele. One horse had recurring preputial edema every 3 to 4 mo. He was euthanized 18 mo after being castrated because of a suspected inguinal abscess. No additional diagnostic procedures or treatment were requested from the ONIRIS equine clinic to confirm this suspicion before euthanasia and no necropsy information was available. The overall clients’ satisfaction with castration with primary wound closure technique was excellent (98%). The effects of different variables on complications of castration are reported in Table 3.

French trotters and horses aged 3 to 6 y appeared at a higher risk of developing complications following primary closure castration, with an odds ratio exceeding 4. In particular, French trotters were at a higher risk of developing a postoperative hematoma than were other horses (P = 0.02; OR = 7.6).

Intraoperative use of electrocoagery (P = 0.02; OR = 0.3) and ligation of the cremaster muscle (P = 0.03; OR = 0.3) appeared to significantly reduce complication rates. Ligation of the cremaster muscle had a significant protective effect on the occurrence of hematoma (P = 0.02; OR = 0.21). Other variables did not show any significant effect on complication rates.

**Discussion**

This study confirms that castration is not risk-free even when performed as a clean surgical procedure in a fully equipped surgical theater with a primary closure technique under general anesthesia. More than 16% of horses developed complication in the short-term postoperative period. These results are worse than those previously reported. Indeed, complication prevalence as low as 2% had previously been reported for primary closure castration (8). However, direct comparison between studies is difficult because of differences in horse populations, surgical techniques, and definition of complications.

In our study, hemorrhage leading to hematoma formation in the scrotal sac was the most frequent short-term complication,
occurring in 7.6% of horses. In previous studies, a prevalence of 1% to 4.8% has been described for hemorrhage (7,9–11). The testicular artery is the likely source of severe hemorrhage, but the most common sources of “dripping” are the richly vascularized skin and tunica dartos (2). Because the skin is closed at the end of surgery it is sometimes necessary to anesthetize the horse a second time to locate the source of bleeding when a fast growing hematoma is the likely source of severe hemorrhage, but the most common sources of “dripping” are the richly vascularized skin and tunica dartos (2). Because the skin is closed at the end of surgery it is sometimes necessary to anesthetize the horse a second time to locate the source of bleeding when a fast growing hematoma occurs and to prevent life-threatening hemorrhage, as observed once in our study (8). In cases in which no source of hemorrhage is found, it is advisable to ligate the spermatic cord and the cremaster muscle again because they are the most likely sources of bleeding (3). However, most scrotal hematomas are managed by incising the scrotum to allow drainage once the clot has collected (10,11). Ultrasound-guided aspiration of blood from the scrotum was used successfully in 1 case of this study. This procedure appears useful for mild to moderate hematomas before clotting occurs. If the hematoma recurs regardless, incising the scrotum is advised.

Postoperative signs of colic that resolved medically were observed in about 4% of our cases, which is in accordance with other authors (10) and with the general horse population having elective surgeries performed in the authors’ clinic. The surgical site is a possible cause of pain, but gastrointestinal assessment is essential to exclude other problems such as cecal impaction.

Fever was observed in 2.5% of the horses and is considered as a normal postoperative response to soft tissue trauma in the first 48 h (10).

Surprisingly, peri-incisional edema had a low prevalence (2%) within the short-term postoperative period compared to other studies in which it could affect up to 38% of the horses (10). This difference could be explained by the systematic use of non-steroidal anti-inflammatory and anti-edema drugs during the perioperative period in the present study and by the different criteria used to define swelling in others. However, 23% of the owners described scrotal or preputial swelling after discharge and discontinuation of anti-inflammatory drugs, which is more comparable to published results, and in accordance with the mean reported delay of 6 d between castration and the time of maximal edema (12).

Interestingly, 5% of horses lost some weight according to their owner. The link with castration is questionable and none of the horses had been re-evaluated in our clinic to quantitatively
assess this problem. It is possible that some of the horses developed a low grade and undiagnosed infection of the surgical site, or even a low-grade hemorrhage (13). Given that all horses survived and owners were satisfied with the technique, such pathologic processes seem unlikely. A postoperative catabolic state could be another possible explanation.

One horse was euthanized because of a suspected inguinal abscess. This was not confirmed at the clinic and thus no information regarding a possible surgical treatment was available. This horse represents the only case of surgical site infection (1%) in the study, which is comparable to other studies (7,8).

No evisceration occurred during the study period, probably because of systematic closure of the vaginal tunic (3). Despite the relatively low number of cases in our study, these results are in accordance with previously published data. Indeed, this life-threatening complication appears rarely using a primary closure castration technique. Only 1 case was reported out of 951 horses when summing cases from 4 studies (7,8,10,11). In comparison, up to 4.8% of draught horses castrated with a field second intention healing technique sustained evisceration (14).

It seems reasonable to recommend primary closure castration to prevent postoperative evisceration, particularly for high risk individuals or breeds.

Overall, client satisfaction was excellent despite some complications, a higher cost compared to an open wound scrotal castration (7), and the need to ship their horse to a clinic with surgical facilities. Most of the owners considered this technique as safer than a scrotal castration for valuable horses aged more than 3 y.

Horses aged 3 to 6 y develop 4 times more complications than other horses. A relationship between age categories and complications has already been proposed. Kummer et al (10) found a higher rate of seromas and edema in horses older than 10 y as well as a tendency for fever to develop in horses less than 10 y. In the same study, middle-aged horses (5 to 10 y old) were prone to develop hematomas, a finding similar to the present study. A possible explanation of this age-related risk factor is the high proportion of young horses in our study population, 62% of them being in the 3 to 6 y category. The mean age of our population was 4.2 y and this may account for the differences observed with the complication rates of other studies.

French trotters seem to be prone to postoperative complications in the present study, and particularly to hematoma formation. Breed sensitivity to castration complications has been reported previously. Standardbreds, Dutch warmbloods, and draft horses have been pointed out to be at greater risk compared to other breeds, especially regarding evisceration (14–16). However, to the best of our knowledge, a direct relationship between postoperative bleeding and Trotters (or Standardbred) has not been established. This could reflect a relative hypertrophy of the vascular network, similar or even related to the larger inguinal rings observed in this breed (16).

This study also identified protective factors for the development of post-castration complications. The first one was ligation of the cremaster muscle, which appeared to play a role in decreasing hematoma formation. The cremaster is a striated muscle coming from the internal oblique abdominal muscle running along the caudalateral aspect of the parietal tunic. It contains the cremasteric artery, which branches from the external iliac artery and measures 0.5 to 1 mm in diameter. It is part of the complex vascular blood supply of the testis, anastomosing with other arteries at the caudal epididymal ligament and in the mesorchium (17,18). We suggest that the cremasteric artery plays a major role in postoperative bleeding and hematoma formation when the cremaster muscle is not properly ligated (3). It is possible that this artery dilates after ligation of the spermatic cord, as suggested previously (17,19). Furthermore, it has been stated that a single ligature around both the cremaster and spermatic cord can loosen upon cremaster contractions. As a consequence, it has been advised to isolate the cremaster from the spermatic cord and to ligate it separately (1).

The second protective factor identified was intraoperative use of electrocautery. We are not aware of any study showing similar protective effects of electrocautery regarding complications in equine surgery. Conversely, in human literature, it appears that electrocautery induces more postoperative seroma, and a significantly higher inflammatory response than regular scalpel or ultrasonic dissector in patients undergoing mastectomy (20).

In equine castration, its protective effect would be a consequence of its direct hemostatic properties. Without electrocautery, small subcutaneous and inguinal vessels can be inadvertently severed using scalpel and scissors. Because of the relative hypotension induced by general anesthesia, bleeding can be minimal during surgery but increased during and after recovery. This could lead to a scrotal hematoma due to primary skin closure and therefore an inability for the blood to drain out of the scrotal sac (1).

Other parameters did not show any significant effect with respect to complications. Among them, concurrent surgery did not increase the incidence of complications, even if a trend had been shown previously (7). However, when post-castration complications occur, they can impede convalescence after a concurrent procedure, often an orthopedic one. Similarly, Barber (21) and Mason et al (7) pointed out the importance of eliminating dead space during closure to limit subsequent hematoma development. Yet, we did not find any association between the closure method and complications. Another interesting point is that ligation of the scrotal ligament did not seem to influence complications although it contains a small artery (18). It is probably because, when not ligated, the scrotal ligament had been bluntly dissected and the artery might have been stretched, allowing some form of hemostasis.

Cryptorchid horses represented 25% of the population. The inguinal approach we used is one of the preferred methods of castration for cryptorchids because it is considered noninvasive (1). However, inguinal removal of abdominal testis sometimes requires dilation of the vaginal ring and subsequent closure of the superficial inguinal ring (4). This procedure may result in profuse bleeding due to insufficient visualization and the presence of large vessels in that area. However, neither the presence of a retained testis nor its location had a significant effect on the occurrence of complications.

One of the limitations of this study is its retrospective nature. Records might have been incomplete or at least imprecise, and have influenced some of the results. Furthermore, the low number of complications might have biased the statistical power.
of the analysis. Finally, long-term complications were based on telephone conversations with the owners, introducing some subjectivity to the outcome.

We conclude that castration of horses with primary closure technique under general anesthesia results in some complications, scrotal hematoma being the most common in the short-term postoperative period. The risk of evisceration was low. It is reasonable to advise owners to elect a primary closure method of castration under general anesthesia in a surgical theater in order to prevent this life-threatening complication, particularly in horses known to be at a particular risk and/or of high value. Attention has to be given to horses aged 3 to 6 y and to French trotters which appeared more prone to develop postoperative complications. However, intraoperative measures can be undertaken to limit their incidence. These assessments need to be confirmed by a multicentric study on a larger population.

Acknowledgments

The authors thank Drs. Marianne Depecker and Emma Steel for their careful review of this article, the referring veterinarians for providing these cases, and the other clinicians of ONIRIS who dealt with them.

References


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Treatment rates for injectable tiamulin and lincomycin as an estimate of morbidity in a swine herd with endemic swine dysentery

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Abstract — Treatment can be used as an indirect measure of morbidity, and treatment records can be used to describe disease patterns in a population. The aim of this study was to describe the rates of treatments with tiamulin and lincomycin by the intramuscular route in cohorts of pigs affected by swine dysentery. Data from treatment records from 19 cohorts of a 1500-head grower-finisher barn were analyzed using Poisson regression to determine factors associated with rates of treatment. Serial interval and reproductive numbers were extracted. Treatment rates displayed marked seasonality. The mean serial interval was estimated at 17 d with variability among batches. In the early period of most cohorts, the effective reproductive number did not exceed 1, and the highest estimate was 2.15 (95% CI: 1.46, 3.20). The average days-to-first treatment was 4.8 which suggests that pigs could have been infected at time of entry. The information about possible sources of infection and likely seasonality should be considered when developing disease and infection control measures in affected barns.

Résumé — Taux de traitement pour la tiamuline et la lincomycine injectables en tant qu’estimation de la morbidité dans un troupeau porcin atteint de dysenterie porcine. Le traitement peut servir de mesure indirecte de la morbidité et les dossiers de traitement peuvent être utilisés pour décrire les profils pathologiques au sein d’une population. Le but de cette étude consistait à décrire les taux de traitement à l’aide de la tiamuline et de la lincomycine par voie intramusculaire dans des cohortes de porcs affectées par la dysenterie porcine. Les données des dossiers de traitement provenant de 19 cohortes d’une porcherie de 1500 porcs d’engraissement ont été analysées en utilisant la régression de Poisson pour déterminer les facteurs associés aux taux de traitement. Des données sur les intervalles sériels et la reproduction ont été extraites. Les taux de traitement ont affiché une saisonnalité marquée. L’intervalle sériel moyen était estimé à 17 jours avec de la variabilité entre les groupes. Au début de la période de la plupart des cohortes, le nombre effectif de reproductions n’a pas dépassé 1 et l’estimation la plus élevée était de 2,15 (IC de 95% : 1,46, 3,20). Le nombre moyen avant le premier traitement était de 4,8 jours, ce qui suggère que les porcs auraient pu être infectés au moment de l’arrivée. Les renseignements sur les sources possibles d’infection et la saisonnalité probable devraient être considérés lors de l’élaboration de mesures de contrôle de la maladie et de l’infection dans les porcheries affectées.

Can Vet J 2017;58:472–481

Introduction

Swine dysentery is characterized by mucohemorrhagic diarrhea in individual pigs, mostly in the grower-finisher stage resulting in high morbidity and mortality (1), with a significant impact on welfare and productivity. Once thought to be controlled by good husbandry practices, the clinical disease has re-emerged in some North American swine populations. Diagnostic investigations have revealed that outbreaks of swine dysentery clinical disease were caused by either *Brachyspira hyodysenteriae*, a causative agent of swine dysentery, or the newly recognized “*Brachyspira hampsonii*” (2). Control strategies include: thorough cleaning and disinfection, strict age separation when possible, rodent control, feed interventions when applicable, and use of antimicrobials to reduce the incidence or severity of clinical disease (1). The detection of severe clinical disease is accompanied by rapid implementation of control strategies which ultimately have an impact on the circulation of the pathogen. This could be one of the reasons why observational studies of swine dysentery at the individual pig level continue to be rare. However, production records in many swine herds are becoming more comprehensive and detailed. The patterns of treatment usage over time in well-defined closed populations are indicative of the development of general morbidity in a herd. Under certain restrictive assumptions, the treatment...
records could have the potential to be utilized for studying the spread of specific infectious diseases within a herd. In this study, we used treatment records in multiple cohorts of pigs to gain insight into the epidemiology of swine dysentery. The first objective was to describe the rates of treatments with tiamulin and lincomycin by intramuscular injection in cohorts of pigs affected by swine dysentery. The second objective was to extract parameters of importance for describing the transmissibility of swine dysentery disease using treatment records as a proxy for morbidity due to the disease.

**Materials and methods**

Inclusion criteria in this study were a grower-finish population with the: i) existence of mucohemorrhagic diarrhea, and diagnostic confirmation of an agent of swine dysentery — *B. hyodysenteriae* or an emerging species of *Brachyspira*, such as "*B. hampsonii," and ii) availability of detailed medication records and mortality on a day-to-day basis in multiple production batches.

**Farm description**

One grower-finisher site with detailed treatment records available in an electronic form over multiple cohorts (batches) was selected. The study site consisted of 3 swine barns located on the same premises in western Canada. The first barn (i.e., grower barn) had a capacity of 1500 pigs, and was the barn in which pigs were first housed when moved to the site. The barn had fully-slatted concrete floors. Animals stayed in the grower barn for 6 wk, and were then moved to 1 of 2 larger finisher barns. The finisher barns had solid concrete floors and used straw bedding. Pigs were housed in finisher barns for approximately 12 wk until the last pigs were shipped to market. There was an additional room to allow for overflow. The grower barn and each of the finisher barns was thoroughly cleaned, washed, dried, and disinfected, with more thorough disinfection being conducted during warmer months. Different batches of pigs were affected by diseases consistent with swine dysentery-like disease, lameness consistent with *Mycoplasma hyosynoviae*, and clinical conditions consistent with infection with *Streptococcus suis* as identified by the barn managers.

**Records**

Detailed close-out data between June 2011 and December 2013 were obtained from the study farm. Data contained information from 19 cohorts including the shipping dates onto and off the farm, number of animals shipped, unique batch ID, and quantity of different types of feed medication delivered to sequential production phases. All types of feed were barley-soybean meal based, and did not change in a substantial manner over the study period. Records on the medication type, date of application, dosage, and number of pigs treated were available for medications delivered through feed, water, and as injectable (IM) treatment. Data on the date of mortality, the likely reason for mortality, and the number of animals affected were also available. Day-to-day records were provided for 19 batches. Injectable medications used included tiamulin hydrogen fumarate (Denagard, 100 mg/mL; Novartis Animal Health Canada, Mississauga, Ontario), penicillin (Procaine Penicillin G, 300 000 IU/mL; Dominion Veterinary Laboratories, Winnipeg, Manitoba), ceftriaxone hydrochloride (Excenel, 50 mg/mL; Zoetis Canada, Kirkland, Quebec), ampicillin (Polyflex, 25 g/250 mL; Boehringer Ingelheim (Canada), Burlington, Ontario), lincomycin hydrochloride (Lincomix 100, 100 mg/mL; Zoetis Canada), and isoflupredone (Predex 2X, 2 mg/mL; Zoetis Canada). Water medications used in at least some of these batches were penicillin (Pot Pen, 500 000 000 IU/pouch; Vétouquinol N.-A., Lavaltrie, Quebec), amoxicillin trihydrate (Paracillin SP, 800 mg/g; Merck Animal Health, Kirkland, Quebec), and tetracycline (Tetracycline 250, 25 g/100 g; Vétouquinol N.-A.). Feed medications used in at least some of the batches included lincomycin hydrochloride (Lincomix 110 Premix; 110 g/kg, Zoetis Canada) and tiamulin hydrogen fumarate (Denagard 10% GF Premix, 100 g/kg; Novartis Animal Health Canada).

In this study, IM treatments with tiamulin and lincomycin were used as indication of clinical cases of the disease that required injectable treatment (i.e., morbidity). Tiamulin was used exclusively to treat clinical disease associated with swine dysentery signs, whereas lincomycin was used to treat swine dysentery disease, as well as lameness due to *M. hyosynoviae* and *M. hyodysenteriae* when used in combination with isoflupredone. During the study period, injectable tiamulin ceased to be commercially available and consequently, only lincomycin was used to treat both swine dysentery disease and disease due to *M. hyosynoviae* and *M. hyodysenteriae* in more recent groups of pigs. Intramuscular application of these 2 antimicrobials was used to calculate 2 types of statistics. For the first set of statistics, treatment rates were calculated for both tiamulin and lincomycin directly from the farm records by summing all of the respective treatments over the duration of a specific cohort. For the second set of statistics, adjustment in the use of lincomycin was done in an attempt to account for lincomycin treatment used specifically for swine dysentery. The difference between the total number of lincomycin treatments and the total number of isoflupredone treatments was calculated for each day in each batch. We assumed that this difference would remove treatments due to *M. hyosynoviae* and would provide a more accurate number of treatments of lincomycin used specifically for swine dysentery. We refer to this statistic as adjusted lincomycin count. Finally, the sum of the total number of treatments due to any tiamulin and adjusted lincomycin was calculated, in an attempt to calculate statistics which will account for all antimicrobial usage likely due to swine dysentery disease in one variable. The incidence of treatment rates per pig-day was calculated with the numerator as the total number of treatments (contributions more than once are possible) and the denominator as the sum of the total number of pig-days. Pig-days were obtained as the total number of days that the given number of animals in a batch spent in a barn. This incidence rate was then multiplied by 1000 to give the average number of treatments per 1000 pig-days. Therefore, 4 outcomes obtained for treatment rates were: tiamulin, lincomycin, adjusted lincomycin (for use of swine dysentery alone), and combined tiamulin and adjusted lincomycin.

Both of these antimicrobials are labeled for treatment of clinical disease due to swine dysentery. Injectable tiamulin is labeled to treat animals showing clinical signs of swine dysentery with the dose of 11 mg/kg body weight (BW) given once.
daily until clinical signs disappear or for a maximum of 4 d and with a withdrawal period of 9 d before slaughter (3). Injectable lincomycin is labeled in Canada for the treatment of swine dysentery especially in moribund animals (3). The recommended treatment is 1 mL of solution/10 kg BW for a period between 3 and 7 d, with a withdrawal period of 2 d before slaughter (3).

**Statistical analysis**

**Analysis of treatment rates**

A statistical program (Stata Version 10; STATA, College Station, Texas), was used to determine treatment rates of the recommended uses of tiamulin, lincomycin, and adjusted lincomycin. The combination of tiamulin and lincomycin was described using descriptive statistics and was compared against the season at the start of the cohort and the season in which the majority of growth occurred for each cohort. Seasons were determined based on calendar time (e.g., the winter season is December 21 to March 20). Season of the batch at the start was determined on the basis of the start date for each batch, whereas season of the batch was assigned on the basis of the season which comprised the majority of the growth period for each batch.

A mixed Poisson regression with batch as a random effect was used to determine factors associated with the treatment rates. Count of treatments was used as the outcome and the total animal time-at-risk per pig-day was used as the exposure. Because of the nature of the dataset, animals could be treated multiple times. Each treatment count was considered for analysis. Table 1 contains description of factors that were considered in the initial analysis. Treatment rates in the previous batches (lag = 1, 2, and 3) were determined by treatment use in the preceding, the second preceding, and the third preceding batch. Each covariate was evaluated in a univariable analysis. Factors associated with treatment rates with $P < 0.20$ were considered for inclusion in the multivariable model. Multivariable models were fit using manual forward selection approach. Biologically plausible interactions of feed medication and injectable treatments were evaluated. Residuals and influence statistics were examined and models were refit.

<table>
<thead>
<tr>
<th>Covariate</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Season (start)</td>
<td>The season the batch spent most of its time on the site. (3)</td>
</tr>
<tr>
<td>Season (batch)</td>
<td>The season when the batch first entered the site. (3)</td>
</tr>
<tr>
<td>Lag (lincomycin)</td>
<td>Comparison of lincomycin treatment rates between previous, 2nd previous, and 3rd previous batches.</td>
</tr>
<tr>
<td>Lag (tiamulin)</td>
<td>Comparison of tiamulin treatment rates between previous, 2nd previous, and 3rd previous batches.</td>
</tr>
<tr>
<td>Feed (lincomycin)</td>
<td>Feed medication of lincomycin used in one of the 3 grower barns, the finisher barn, or any of these barns.</td>
</tr>
<tr>
<td>Feed (tiamulin)</td>
<td>Feed medication of tiamulin used in one of the 3 grower barns, the finisher barn, or any of these barns.</td>
</tr>
</tbody>
</table>

**Disease transmission parameters**

In this study, 3 parameters of importance for the natural history of disease in this population were estimated: i) serial interval, ii) reproductive number, and iii) minimum time between introduction of animals into the barn and the first treatment with IM treatment suggestive of swine dysentery. For all 3 parameters, treatment with tiamulin was used with a rationale that this treatment in this population was most reflective of clinical swine dysentery, and was implemented in the early stages of growth and potential outbreaks of swine dysentery.

A series of serial intervals was generated from the raw data using the following approach. The data for serial interval were extracted from tiamulin use first by displaying the daily count of tiamulin treatments within the first 45 d for each batch separately. The day of the first peak (i.e., the mode) of cases in the early period served as a baseline day for the calculation of the serial interval. Then, cases in the second wave of treatments were identified and the baseline day was subtracted from the days that each case in the second wave occurred. Although more data were available, we only considered batches in which the 2 waves could clearly be separated, and did not extend beyond that due to any discrepancies that may occur with subsequent waves. The best fitting parametric distribution was fit to the observed series of serial interval using functionality provided in R (Version 3.03; University of Auckland, New Zealand), package R0 (4). Following that, in the package R0, the effective reproductive number ($R_e$) was estimated from the exponential growth rate of the outbreak as previously reported in a study done examining how serial intervals affect growth rates and reproductive numbers (5). The observed number of treatments with tiamulin over the first 45 d was used to generate the growth rate of the epidemic, and from parametric distribution (Weibull) estimated from the series of serial intervals. The effective reproductive number ($R_e$) is the average number of secondary infections resulting from a single infection per unit of time in a given heterogeneous population (i.e., some animals are immune), and is also known as the net reproductive number ($R_n$) (6). The time to first treatment with injectable tiamulin in the grower barn was calculated for each batch.

**Literature search**

An ad-hoc literature search was performed to determine the duration of some important periods which were summarized either using descriptive statistics, such as averages, or by using random-effect meta-analysis if the quality of reported data allowed for that. For the current purposes, a random effects meta-analysis was conducted to estimate the incubation time of swine dysentery from experimental challenge studies with confirmed infection of the bacteria in swine. Incubation time is defined as the time from being infected to the time when clinical signs first start to show.

**Results**

Only 11 cohorts had information on tiamulin usage (excluding batch 2) and batch 13 onwards did not have record information on injectable tiamulin. The mean number of the maximum pigs in a cohort was 1493 pigs with a standard deviation
23.3 pigs. The average weight of the pigs when entering the site was 24.1 kg (± 2.5 kg). The minimum average weight was 20.0 kg and the maximum average weight of entering pigs was 29.7 kg. Barn turnover for this site was an average of 144.4 d (± 6.3 d), minimum of 131 d and maximum of 150 d. On the basis of entry and exit date for each cohort, animals from between 3 and 4 cohorts were present on-site at the same time. The mean risk of mortality (calculated by the number of deaths in each batch over the number of pigs that started) was 3.78% (± 0.82%) and ranged between a minimum of 2.5% and a maximum of 5.33%. Most deaths (89%) were due to septicemia, as defined by the herdsperson, followed by deaths, as listed in the production data, caused by *S. suis* (2.8%), and being a poor-doer (i.e., a pig with slow growth) (1.7%). The most common proportional causes for euthanasia included lameness (62.9%), being a poor-doer (18.9%), and being a downer pig (i.e., a pig that is not able to stand before being taken to slaughter) (6.9%). The cause of mortality on a farm was determined by a herdsperson and did not include any diagnostics; therefore, it was syndromic, aimed to capture major clinical problems, and could include different clinical signs with the same etiology. Results of diagnostic testing during the study period indicated presence of several *Brachyspira* species, including *B. hyodysenteriae* and *B. hampsonii*. However, clinical cases were predominantly detected with *B. hampsonii*. The underlying clinical issue with *M. hyosynoviae* was confirmed through diagnostic testing based on polymerase chain reaction (PCR), and with *S. suis* through bacteriological culture of appropriate samples. All tests were conducted at the herd-level and not every affected pig or batch was sampled for diagnostic testing.

### Intramuscular treatments with tiamulin and lincomycin

The mean number of injectable treatments in this dataset was 0.17 per 1000 pig-days (± 0.20, min = 0, max = 0.50), 1.58 per 1000 pig-days (± 1.01, min = 0.53, max = 3.69), 1.08 per 1000 pig-days (± 0.66, min = 0.22, max = 2.52), and 1.24 per 1000 pig-days (± 0.72, min = 0.22, max = 2.84) for tiamulin, lincomycin, adjusted lincomycin, and tiamulin and adjusted lincomycin combined, respectively. Figure 1 depicts the total number of treatments per cohort for all 4 outcomes of interest when stratified by the calendar season when the pigs entered a barn for the first time. Total number of treatments for tiamulin was, on average, the lowest if the batch started in the winter, followed by spring, summer, and fall. Lincomycin showed the highest number of treatments in the fall, followed by winter, spring, and summer. Adjusted lincomycin and tiamulin and adjusted lincomycin combined showed a similar trend, with the highest number of treatments in the fall and the lowest in the winter.

**Figure 1.** Box plot of total count of intramuscular treatments with tiamulin (A), lincomycin (B), adjusted lincomycin (C), and tiamulin and adjusted lincomycin combined (D). Counts represent total count of treatments in each batch stratified by the season when the batch was introduced to the farm. For each plot, the whiskers represent the values that are within 1.5*IQR of the nearest quartile, the median treatment use is represented by the white line within each box. The lower edge of the boxes represent the 25th percentile, and the upper edge of the boxes represent the 75th percentile. The asterisks displayed outside the error bars represent outlier values.
winter, although there seemed to be considerable variability in the number of tiamulin treatments in each season (Figure 1A). In contrast, treatment with lincomycin showed a different pattern (Figure 1B). Batches that started in the fall had on average the highest number of lincomycin treatments, followed by the winter batches; and batches that started in spring had on average the lowest number of treatments. Adjustment of lincomycin treatment counts with isoflupredone, accounting for treatment reflective of swine dysentery disease, did not change the overall pattern (Figure 1C). A similar pattern was observed for the sum of tiamulin and lincomycin treatment (Figure 1D).

Figure 2 depicts the summary of the number of treatments with tiamulin and lincomycin by the season in which most of the growth occurred (i.e., season of growing). Batches in which pigs grew predominantly in winter continued to have the lowest number of treatments with tiamulin, followed by cohorts in which pigs predominantly grew in summer (Figure 2A). The number of treatments with lincomycin, adjusted lincomycin, and adjusted lincomycin and tiamulin combined were on average highest in the winter, followed by the spring (Figures 2B, C, D). Overall, lincomycin treatment counts were highest in the fall and winter when season of the start was considered and highest in the winter and spring when season of the batch was considered.

Lincomycin treatment was used in the later parts of growing for the earlier batches, but for the later cohorts, lincomycin treatments were administered earlier as a result of the cessation of the use of tiamulin. The highest count of lincomycin treatment used across the batches ranged from Day 19 to Day 119 in the dataset. The mean total number of lincomycin treatments used was 191.9 (± 127.8, min = 49, and max = 494). In comparison, the maximum tiamulin treatments administered ranged from Day 4 to Day 38 in the provided dataset. The mean total number of tiamulin treatments across the batches was 28.5 (± 33.6, min = 0, and max = 86).

**Risk factors for tiamulin and adjusted lincomycin usage**

Results from the univariable and the final multivariable mixed Poisson regression for the tiamulin and the adjusted lincomycin rates are shown in Tables 2 and 3, respectively. According to the multivariable model, the use of in-feed lincomycin was associated with the lower rates of IM tiamulin usage (Table 3). For the tiamulin treatment rates, compared with a batch starting in...
the winter, there was a higher use of tiamulin in batches that grew in spring, summer, or fall compared with batches that mostly grew in winter (Table 3). Nonetheless, no statistically significant difference could be detected in the rates of tiamulin use for batches that grew in spring compared with summer ($P = 0.22$), or to fall ($P = 0.57$). Similarly, no difference in tiamulin treatment rates were observed between summer and fall ($P = 0.39$). Residual diagnostics identified 2 potential outliers. Their joint omission from the model resulted in a decrease in the incidence risk ratios for all seasons. The summer ($P = 0.48$) and fall ($P = 0.06$) seasons were not statistically significant any more when compared with winter. Nonetheless, the direction of association and statistical significance for the spring season did not change. These 2 potential outliers represented early batches and were kept in the model.

For the final adjusted lincomycin model, the start of the season for the batch was more statistically significant than the primary season of growth of the batch. Including both the season of the start of the batch and the season of the batch would cause collinearity issues; therefore, only the start of the season for the batch was included in the final model. Batches that started in the spring and summer had less lincomycin usage than batches that started in the winter. In contrast, batches that started in the fall season had greater lincomycin usage than batches that started in the winter. In contrast, batches that started in the spring and summer had less lincomycin usage than batches that started in the winter. In contrast, batches that started in the spring and summer had less lincomycin usage than batches that started in the winter. In contrast, batches that started in the spring and summer had less lincomycin usage than batches that started in the winter. In contrast, batches that started in the spring and summer had less lincomycin usage than batches that started in the winter.
than those that started in the winter. Batches that started in the spring had less lincomycin usage than those that started in the summer, but this was not statistically significant (IRR = 0.74, 95% CI = 0.50 to 1.09, \( P = 0.13 \)). Batches that started in the spring and summer had less lincomycin usage than cohorts that started in the fall; both were statistically significant (IRR = 0.27, 95% CI = 0.18 to 0.41, IRR = 0.36, 95% CI = 0.24 to 0.55; respectively \( P < 0.001 \)). Residual analysis of the best linear unbiased predictions (BLUPs) identified one potential negative outlier, but its omission did not change the direction or significance when compared to the full adjusted lincomycin model. Therefore, this outlier was kept in the final model for adjusted lincomycin.

**Disease transmission parameters**

Based on the tiamulin treatments of the data and the early grower phase of production (~45 d), the distribution of the observed serial intervals is depicted in Figure 3, together with the best fitting parametric distribution, which was determined to be Weibull distribution with mean of 17.2 d (± 5.25 d). The histogram representing the series of serial intervals extracted from all eligible cohorts showed 3 distinct modes at 9, 15, and 21 d (Figure 3).

The effective reproductive number found using the serial interval ranged from 0.07 to 2.15. The only cohorts when the \( R_e \) was greater than 1 and statistically significant were batches 4 and 9 as indicated by asterisks on Figure 4 showing the effective reproductive number for each batch. The average time to first treatment with tiamulin was 4.2 d (± 1.7 d, min = 2, and max = 7) and the average time to first treatment with lincomycin was 17.4 d (± 21.7 d, min = 0, and max = 63), whereas for adjusted lincomycin the mean time to first treatment was 24.6 d (± 21.6 d, min = 2, and max = 63). In order to evaluate time to first treatment with adjusted lincomycin, we compared descriptively time to first treatment with adjusted lincomycin in batches that used tiamulin (\( n = 11 \)), and batches that did not use tiamulin (\( n = 8 \)). The mean times to the first treatment with adjusted lincomycin in batches that did and did not use tiamulin were 31.7 d (± 21.4 d) and 14.7 d (± 18.8 d), respectively. The median times were 39 d and 7.5 d, respectively and the minimum was 2 d in both types of batches.

![Histogram representing a series of serial intervals extracted from early growing phase on the basis of treatments with tiamulin. The X-axis represents the serial interval measured in days. The multiple modes represent the variability of serial intervals. The mean serial interval was calculated to be 17.2 days.](image)

**Figure 3.**

![Effective reproductive number (\( R_e \)) for each batch approximated using intramuscular tiamulin treatments. Each circle indicates the mean \( R_e \) and the error bars are the 95% confidence intervals of the estimate. \( R_e \) indicates transmissibility of the disease and the dashed line on this figure represents the epidemic threshold (\( R_e = 1 \)). Any number above this threshold theoretically results in an outbreak or indicates sustained transmission of disease.](image)

**Figure 4.**

Estimates of incubation time

The incubation time of this disease based on the literature search was an average of 11.2 d (95% CI = 10.4 to 12.3) (7–17). More specifically, \( B. \) *hyodysenteriae* and \( B. \) *hampsonii* had incubation periods averaging 11.9 d (95% CI = 10.4 to 13.3) (7–14,17) and 8.1 d (95% CI = 7.2 to 9.1) (16–18), respectively.

**Discussion**

The median time to first treatment with adjusted lincomycin was much shorter (7.5 d) when tiamulin was no longer available as a treatment option compared to when tiamulin was used (39 d), and was similar to the first treatment with tiamulin (4.25 d). This shorter time to the first treatment is expected as lincomycin was used as the only choice for swine dysentery in later batches and for treatment of pigs in early production stages that would otherwise be treated with tiamulin. However, as this is a dynamic disease it is difficult to speculate whether descriptively longer time to the first treatment with adjusted lincomycin than with tiamulin is a consequence of the choice related to the administration of a specific treatment, a change in disease dynamics (e.g., later onset of clinical signs), or inaccuracy in adjusting the lincomycin treatment rates.

Patterns of tiamulin and lincomycin usage were different between seasons, but this could be more due to treatment protocols and procedures for the use of the 2 antibiotics in different production phases, than to the disease itself. The fact that a clear association between the treatment rates in sequential cohorts could not be identified could be a result of sanitation and other infection control measures that were applied between different batches. These measures were perhaps not sufficient to completely eliminate the infection, but were adequate to remove most of the environmental contamination and remove temporal autocorrelation in treatment rates.

Seasonality of lincomycin usage was more in line with the epidemiology of the disease, expected to be more frequent
during colder temperatures, as a previous report showed that *B. hyodysenteriae* could survive in pig feces for 112 d, in a mixture of pig feces and soil for 78 d, and in soil for 10 d at 10°C under laboratory settings (19). Others reported that *B. hyodysenteriae* is able to survive in pig feces for 48 d at a temperature between 0°C and 10°C (20). This is in line with longer survivability of the causative agent at colder temperatures which could contribute to higher environmental contamination and increased opportunity for fecal-oral transmission. Thorough cleaning is also generally harder to achieve during colder months, and this could increase the level of initial contamination and consequently influence the pattern of transmission and the total treatment rate. It is also possible that pigs are more susceptible to clinical swine dysentery during colder months due to higher incidence of other diseases, either gastrointestinal or immunosuppressive. Interestingly, the use of lincomycin in the previous cohorts was not predictive of the rates of lincomycin usage in a current cohort.

The seasonal pattern of tiamulin usage was different. At first glance, it would appear that tiamulin usage was a more reliable indicator of swine dysentery disease because it was used just for the treatment of swine dysentery. However, this has to be considered in the light of the following facts. First, this treatment was used only over the first ~40 d of the growing period, which is not sufficient to fully depict the burden of swine dysentery and could be influenced by other interventions such as in-feed antimicrobials. In fact, implementation of feed antimicrobials significantly decreased the rate of tiamulin usage before and after adjusting for season, but had no impact on the use of lincomycin. This farm was transitioning towards an antibiotic-free program which could further influence the shape of this association. Second, seasonality in the use of tiamulin was influenced by 2 influential cohorts. Once they were removed from the model, season was not statistically associated with the rate of tiamulin usage. Thus, the idea that tiamulin usage was most indicative of the swine dysentery morbidity could indeed be valid, but only for the early stage of growing. In fact, this feature has been utilized in this analysis to extract parameters important for understanding of natural history of disease, such as the effective reproductive number.

The effective reproductive number, R_e, estimated in this study based on tiamulin treatments in the initial stage was relatively low and did not exceed a value of 1 in many of the batches in this study. This could be because the pigs spent the first 6 wk in an environment in which it is easier to implement biosecurity measures such as disinfection and more efficient manure removal through fully slatted floors. In-feed antimicrobials could possibly decrease the likelihood of expressing classic clinical signs of the disease, and change the overall infection dynamics. But the R_e continued to be low even in cohorts that did not have in-feed antibiotics. A combination of a low number of clinical and possibly infectious animals during this early stage, a high sensitivity of case definition and therefore early detection, and an effective intramuscular treatment which reduces morbidity and duration of shedding could also have contributed to a low estimate of the reproductive number in this early stage. The second barn environment to which the pigs were moved was different in that there was straw bedding, which could have changed the infection dynamics with consequent impact on transmissibility. We did not consider lincomycin usage data to estimate R_e in part because it was more difficult to determine what represented the starting point of the outbreak, and partly because there was higher variability in the number of possible treatments per individual case under labeled use. Regardless of this, the fact remains that this disease has a strong environmental component, and because of that, measuring transmissibility through the use of reproductive number could be limited. However, such an approach has been used previously for infections with similar transmission routes (21). Thus, although we can expect that estimates of transmissibility could change in different studies and under different conditions, together with the approaches to evaluate transmissibility, we believe that current estimates could represent useful initial estimates of this source population — and of similar populations. These initial estimates could allow studying some aspects of epidemiology of swine dysentery using disease modelling approaches. The serial interval is another essential parameter in studying infectious diseases at the population level, rarely utilized in animal health. It is defined as the time “between successive infections in a chain of transmission” (6). In this study it was estimated at approximately 17 d, but it varied between cohorts. This serial number is essential for the estimation of R_e, and on its own suggests that successive waves of infections could be expected to occur in a little over a 2-week window — with some variability among cohorts.

The average time to first treatment in this study from these production data was 4.2 d and 24.6 d for tiamulin and adjusted lincomycin treatments, respectively. This result is shorter than the average incubation time of 11.5 d published in the literature. Consequently, this suggests that first clinical cases of swine dysentery disease were due to infection that was introduced from a source herd before arrival of the pigs on-site. However, it is difficult to determine the level of clinical signs of swine dysentery and whether some animals treated with tiamulin were misdiagnosed.

The estimate obtained from meta-analysis of a limited number of published reports indicated that the incubation time was 11.2 d (95% CI = 10.4 to 12.3), suggesting that time to first treatment was shorter than the average incubation time. However, this estimate should be used with care for several reasons. The 95% CI relates to the expected mean of studies, not of individual animals. It is expected that variability among individual animals would be much higher, and therefore some animals could have much shorter incubation times. In the latter case, it is possible that animals are infected in the barn itself. Secondly, most of the estimates used for meta-analysis were obtained under experimental conditions, and the incubation time could be linked to dosage, strain, environmental conditions, feed, and age of animals. For example, Wilberts et al (17) reported an average incubation time of 12.2 d, with a minimum of 7 d, when pigs were fed standard diet with 0% corn DDGS and challenged with *B. hyodysenteriae*, and an average incubation time of 6.8 d, with a minimum of 5 d when the pigs were fed with 30% of corn-based DDGS. Composition of feed also had substantial impact on incidence and severity of clinical disease and other parameters in other studies (22–24). In this study,
feed was barley and soybean-meal based and did not change substantially over the study period. Hence, it should not be a major source of confounding bias for associations detected in this study. The nature of measurements herein does not allow us to make strong conclusions about the incubation time. Nonetheless, 2 points are worth considering. First, in the early phases of recurrent outbreaks of diseases such as swine dysentery, extra effort should be made to estimate the time until the first set of confirmed cases. Secondly, the infection status of the source herds is worth investigating as a part of the overall infection control strategy, despite anticipated challenges such as possible low prevalence of infection in the source herds.

This study is subject to some limitations, the most severe of which is the possibility of misclassification bias. Tiamulin was used exclusively for swine dysentery clinical signs and lincomycin was used for swine dysentery diseases and for other conditions such as lameness due to M. hyopneumoniae. We attempted to adjust lincomycin treatment used only for swine dysentery by subtracting the isoflupredone treatments. The pattern of lincomycin usage did not change in a qualitative way after this adjustment. Validity of results would have been greatly enhanced if the reason for treatment was recorded. This is done in many herds and would create little additional work. Results of this study represent only 1 farm, hence external validity is limited. We also used treatments as if they were measures of individual morbidity, but labelled treatment for tiamulin is to be used until clinical signs ceased and for lincomycin is between 3 and 7 d. This is one of the reasons why only tiamulin was used for estimation of disease parameters, but it is far from a perfect approach. The study should be repeated prospectively and across multiple systems or farms.

Despite these limitations, some important insights into the patterns of circulation of swine dysentery under current conditions were gained. Although there was endemic presence of swine dysentery in this system the overall mortality did not seem to be driven by acute cases of swine dysentery, which is not reflective of historical reports. More age separation, disinfection protocols, and overall environment quality are possible contributing factors. Under the assumption that the rate of adjusted lincomycin usage was the most reflective of the burden of swine dysentery over the entire period, the average morbidity could also be considered relatively low. As an example, with a treatment rate of 1.08 per 1000 pig-days, a population of 1500 animals and a 120-day finisher period, one could expect 194.4 treatments in this population. With the additional assumption that each animal received 3 injections, we could expect ~65 treated animals (4.3% swine dysentery morbidity). Although of concern for animal health and welfare, such estimates are far lower than historical descriptions of the disease. Nonetheless, the rate of treatment with lincomycin — and thus morbidity — is expected to vary substantially among seasons with the highest rate for animals raised in winter months and the lowest rate for animals raised during summer.

Acknowledgments
This study was funded by the University of Guelph-Ontario Ministry of Agriculture, Food and Rural Affairs Research Partnership (Emergency Management Research theme). The authors greatly appreciate the assistance of the producer who provided valuable data for this analysis.

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Current Therapy in Avian Medicine and Surgery


The most comprehensive volume of its kind to date. This first edition encompasses the most up-to-date information on the subject, including a wealth of new information not included in other texts. This book is an in-depth, evidence-based discussion on avian therapy, including sections on medicine, anesthesia, analgesia, and surgery, welfare, conservation, and practice management, and pattern recognition. While definitely not a quick reference to be used in emergency situations, this book offers the veterinarian an opportunity to become well-versed in the most current information on avian illness and injury. Subjects such as infectious disease, oncology, nutrition, behavior, cardiology, neurology, and endocrinology are covered in depth. There are individual chapters on specific anatomical regions, including the cloaca, coelomic cavity, and endocrine system. Sections on hematology and cytology include photographs and tables to aid in-house diagnostics when an immediate answer is required. There is a chapter devoted specifically to management and medicine of backyard poultry, which is useful even in urban practice given the current popularity of having a small backyard flock. Information on pain management goes beyond the usual pharmacology discussion found in most avian texts, to include a discussion on recognition and assessment of pain in birds. The one omission to this chapter that would be useful is a pain scale; the author discusses their usefulness but fails to include an example. The pain management chapter does include a useful drug formulary, however, with differences among avian species noted.

The section on surgery contains less detail about individual procedures than most general practitioners would probably require. There are a few photographs but hardly any diagrams, so this is not a text to use if you want, for example, a step-by-step approach for performing your first avian castration. There are some useful photos in the orthopedics section that would aid in applying external coaptation. Pattern Recognition is a brief section primarily of charts and tables to aid the practitioner in making a diagnosis. It includes tables of diseases found in common species, and indicates which conditions are likely to be found in that species depending on which part of the world they are kept as pets.

An appendix is included for common drugs and approximate doses, divided by class (e.g., antibacterial, antifungal) and listed alphabetically, making it easier to select a treatment compared to using a general veterinary drug formulary. The text also includes up-to-date tables for hematology and biochemistry, with different values for individual species of birds, which provides a more diagnostic value than most other discussions of avian clinical pathology, which seem to include only one value for all avian species.

This book is highly recommended for mixed practitioners with an avian component to their practice, and for those looking to specialize into avian and exotic medicine exclusively.

Reviewed by Lynn Smart-Ridgway, DVM, Cascade Veterinary Clinic, Princeton, British Columbia.
Article

Information needs, sources, and decision-making by hatching egg and broiler chicken producers: A qualitative study in Alberta, Canada

R. Michele Anholt, Margaret Russell, Tom Inglis, Darko Mitevski, David Hall

Abstract — Understanding the sources and use of information from hatching egg and broiler chicken producers, their constraints, and unmet information needs can help define future research agendas. This report presents the results from a qualitative study using interviews of 11 hatching egg producers and 12 broiler producers in Alberta, Canada. Patterns were reported and described using thematic analysis. Producers recognized that there were numerous sources of information available to them for managing disease in their flocks. Complex disease issues such as early mortality were discussed, but many producers did not believe they had any influence over the outcomes and did not see a benefit from additional information to improve outcomes. Producers described their experience, trust in the information source, and the usefulness of the information for decision-making as necessary for information uptake.

Introduction

Acquiring and using information is the foundation for decision-making. The goal of production animal research is often to provide evidence-based advice to producers. However, producers may not apply the new information (1–4). Increasingly, attention has focused on how to promote the uptake and implementation of agricultural innovation and disease prevention strategies by food animal producers (5–7). This study examined how hatching egg (broiler breeder) producers (HEP) and broiler (chicken) producers (BP) acquire and use information in their decision-making.

In Alberta, day-old broiler breeder chicks are imported from the United States, and HEPs raise the chicks and continue to own them throughout production of hatching eggs, which are then delivered to a hatchery. The hatchery pays the HEP for each viable chick hatched from the delivered eggs. The day-old broiler chicks are then sold to BPs to be raised until processing. Hatching egg and broiler chicken production is supply managed in Canada and commercial producers are required to hold quota to produce and sell their products. The HEPs and the BPs in Alberta are serviced by field staff provided by the agri-food corporation (hatchery), veterinarians (who may also be under contract to an agri-food corporation), feed suppliers and nutritionists, and a poultry diagnostic laboratory. Veterinarians, nutritionists, and hatchery advisors together develop flock health programs for their producers. The programs include flock management, feeding, vaccination protocols, and disease management protocols.
The purpose of this study was to inform future research projects and provide evidence-based advice to the Alberta poultry industry. Our objectives were to explore how HEPs and BPs currently make decisions about routine flock management, their approaches to disease challenges in their flocks, their motivations for responding to problems, sources of information, and neglected information needs.

**Materials and methods**

This was a qualitative study. Data were collected by telephone interview and then thematically analyzed.

**Participant recruitment**

Participants were identified by using the client database from a poultry diagnostic service in the province of Alberta. Poultry submissions to this diagnostic service come from producers serviced by 3 veterinary practices and under contract to 1 of 3 agri-food corporations or producing broilers for their own use. All quota HEPs (n = 26) in the province were identified as potential participants. Broiler producers were selected using a random sample (n = 40), stratified by region, of the 200 producers in the client list. With the expectation of a 25% response rate, the sample size was judged to provide a sufficient number of participants so as to reach informational redundancy and still allow sufficient time for thorough analysis (8). The 66 producers were initially contacted by e-mail, facsimile, or mail depending on available contact information. The letter requesting their participation introduced the investigators, and the objectives and methods of the project. In the month following, attempts were made to contact each producer by telephone; 2 attempts were made for each producer. When telephone contact was established, the project was again described and informed consent was obtained. A time for the interview was then scheduled. No remuneration, or other incentive, was provided.

**Ethics**

This research was approved by the University of Calgary Conjoint Faculties Research Ethics Board. Potential participants were assured that their data would be anonymous and they were informed of their right to refuse to answer any or all of the questions.

**Interview method**

Interviews were conducted by the lead author (RMA) using a semi-structured interview guide. An initial interview guide was developed with input from practicing poultry veterinarians and poultry marketing board members. The interview was piloted with a poultry board member. After the piloting interview and the 2 initial interviews, the questionnaire was changed slightly to improve the logical order and coherence of the questions. The final interview guide was composed of 4 parts.

The first section, “Description of Participant,” gathered demographic information about the producer, his/her background in the poultry industry, and the rewards and concerns they described working in the poultry industry. The second section identified whether there were additional decision-makers on-farm and how decisions were made regarding routine management of flocks. The third section asked about their experience managing disease in the flocks. Our aim was to understand when the producers sought additional information, sources of information, why consultation was or was not sought, and motivation for responding to changes in flock health. Producers were asked specifically if there were any gaps in available information that would be useful for decision-making. The final section asked what methods of communication worked best for them, if they were willing to share data about flock performance with other parties, and under what circumstances they would be less willing to share this information.

The producers’ responses were recorded using handwritten notes, which were transcribed by the interviewer immediately following the interview.

**Thematic analysis**

Qualitative analysis was performed using QDA Miner 3.2.6 software (Provalis Research, Montreal, Quebec) to manage the data files. Our analytic approach was an applied thematic analysis as described by Guest et al (9). Broad, general themes were developed which largely mirrored questions in the interview guide. Through careful reading of the transcripts, meaningful text was segmented and the content was coded using a hierarchical coding structure. The lower level codes under each theme represented more specific ideas or beliefs. Word searches and keywords-in-context were used to provide more detail in selected codes. A codebook was developed that described the relationship of the key words to the code and its associated theme, provided detailed definitions of each code, and provided explicit textual clues to help differentiate the code from similar codes.

To refine the codebook, 6 randomly selected interviews were independently coded by 2 analysts. The 2 analysts reviewed the results together. Where they disagreed, they discussed the discrepancy and alternative interpretations, recoded the segment with an agreed-upon code, and revised the codebook and the code definitions if necessary. The remaining interviews were coded by 1 analyst using the refined codebook.

Participant attributes were summarized using descriptive statistics. The frequencies of codes and co-occurrences of selected codes were examined to identify and explore relationships in the data.

**Results**

**Producer characteristics**

Twenty-three producers (HEP, n = 11; BP, n = 12) were interviewed from April 29, 2014 to June 9, 2014. Of the 15 HEPs who did not participate, there was no response from 11 of the producers, we had the wrong contact information for 3, and 1 producer declined to participate due to time constraints. There was no response from 18 of the 28 BP’s we attempted to contact, 2 were no longer raising chickens, we had incorrect contact information for 3 producers, and 6 producers declined to participate. The reasons for not participating were time constraints (n = 1) and lack of interest (n = 5). The number of participating producers was sufficient to meet our targeted sample size.

The duration of the HEP interviews averaged 32.5 min [standard deviation (SD) = 8.4 min] and averaged 19.8 min
(SD = 5.5 min) for the BP interviews. The demographic characteristics of the HEPs and the BPs were similar except for their levels of education (Table 1).

All participants indicated that they were responsible for making decisions regarding the care of their flocks. Twelve of the producers involved their spouse or other family members in the decision-making, 7 were the sole decision-makers, and 4 discussed concerns and plans with other men on the Hutterite colony.

**Themes and codes**

Nine themes, which reflected the interview questions, were developed: Rewards, Concerns, Disease Experience, Problem Recognition, Information Sources, Motivation, Response, Gaps, and Sharing. Under each theme there were 2 to 6 codes derived directly from the data (Table 2).

Two crosscutting concepts were identified. These were relevant to several themes and provided some degree of integration and coherence between themes. The crosscutting concepts were: i) role of experience, and ii) importance of trust (Table 3).

The data were examined by cross-tabulating themes with the demographic data and comparing the results to determine if there were any relationships between the demographic characteristics of the producers and the codes derived from their interviews. There was no evidence of a relationship between the producers’ age, level of education, time in the industry, location in the province, the hatchery with which they were under contract, flock size, membership in a Hutterite colony, and their responses to the interview questions. However, there were differences between the HEPs and the BPs in the codes and key words that emerged from responses to some questions.

**Rewards.** The HEPs and the BPs responded alike to the question about what they perceived as the rewarding aspects of working in the poultry industry (Table 2). Most producers identified the industry as being profitable and stable, providing a preferred lifestyle and/or rewarding work.

**Concerns.** The BPs had few concerns for themselves or their families working in the poultry industry now and in the future. Concerns about a poor work/life balance and the difficulty finding the workers necessary to meet their labor needs were unique to the HEPs.

**Disease experience.** Responses to the question about the producers’ experiences with disease in their flocks were coded as No major disease problems, Problems that were solved, and Challenging disease problems (Table 2). Some producers responded to questions about disease experiences with a description of an acute disease associated with severe morbidity or mortality, but which had since been managed (e.g., infectious laryngotracheitis). They may not identify the losses due

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**Table 1. Demographic and farm characteristics of poultry producers who participated in this study**

<table>
<thead>
<tr>
<th>Variable</th>
<th>HEP&lt;sup&gt;a&lt;/sup&gt;</th>
<th>BP&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 11 (%)</td>
<td>n = 12 (%)</td>
</tr>
<tr>
<td>Male</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Married/children</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Age [mean ± SD (y)]</td>
<td>47.9 ± 12.3</td>
<td>44.2 ± 9.5</td>
</tr>
<tr>
<td>Education</td>
<td>High school not completed</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>High school completed</td>
<td>3 (27)</td>
</tr>
<tr>
<td></td>
<td>High school and technical training</td>
<td>2 (18)</td>
</tr>
<tr>
<td></td>
<td>Some post-secondary</td>
<td>4 (36)</td>
</tr>
<tr>
<td></td>
<td>University degree, college diploma</td>
<td>2 (18)</td>
</tr>
<tr>
<td>Hutterite</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Years in industry [mean ± SD (y)]</td>
<td>18.4 ± 8.5</td>
<td>18.8 ± 12.7</td>
</tr>
<tr>
<td>Location in province</td>
<td>North</td>
<td>3 (27)</td>
</tr>
<tr>
<td></td>
<td>North-central</td>
<td>1 (9)</td>
</tr>
<tr>
<td></td>
<td>South-central</td>
<td>6 (55)</td>
</tr>
<tr>
<td></td>
<td>South</td>
<td>1 (9)</td>
</tr>
<tr>
<td>Hatchery</td>
<td>Hatchery A</td>
<td>4 (36)</td>
</tr>
<tr>
<td></td>
<td>Hatchery B</td>
<td>2 (18)</td>
</tr>
<tr>
<td></td>
<td>Hatchery C</td>
<td>5 (45)</td>
</tr>
<tr>
<td>Flock Size (per cycle)</td>
<td>&lt;15 000</td>
<td>4 (36)</td>
</tr>
<tr>
<td></td>
<td>15 000 to 25 000</td>
<td>4 (36)</td>
</tr>
<tr>
<td></td>
<td>25 000 to 50 000</td>
<td>3 (27)</td>
</tr>
<tr>
<td></td>
<td>&gt;50 000</td>
<td>0</td>
</tr>
</tbody>
</table>

<sup>a</sup> Hatching egg producer.  
<sup>b</sup> Broiler producer.  
SD = Standard deviation.
Table 2. Frequencies of themes, codes, and key words derived from an applied thematic analysis of producers’ responses

<table>
<thead>
<tr>
<th>Themes</th>
<th>Codes</th>
<th>Key Words</th>
<th>Breeder n (%)</th>
<th>Grover n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rewards</td>
<td>Profitable/stable</td>
<td></td>
<td>3 (27)</td>
<td>3 (25)</td>
</tr>
<tr>
<td></td>
<td>Lifestyle</td>
<td></td>
<td>6 (55)</td>
<td>6 (50)</td>
</tr>
<tr>
<td></td>
<td>Rewarding work</td>
<td></td>
<td>6 (55)</td>
<td>6 (50)</td>
</tr>
<tr>
<td>Concerns</td>
<td>Work life balance</td>
<td></td>
<td>4 (36)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Meeting labor needs</td>
<td></td>
<td>2 (18)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Loss of supply management</td>
<td></td>
<td>8 (73)</td>
<td>3 (25)</td>
</tr>
<tr>
<td></td>
<td>Other struggles</td>
<td>Inadequate revenues</td>
<td>3 (27)</td>
<td>1 (8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High quota value</td>
<td>2 (18)</td>
<td>1 (8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Poor bird quality</td>
<td>3 (27)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>No concerns</td>
<td></td>
<td>0</td>
<td>5 (42)</td>
</tr>
<tr>
<td>Disease experience</td>
<td>Problems solved</td>
<td></td>
<td>3 (27)</td>
<td>3 (25)</td>
</tr>
<tr>
<td></td>
<td>Challenging problems</td>
<td>Early mortality, bird quality</td>
<td>10 (91)</td>
<td>9 (75)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cocci and/or <em>Staphylococcus</em></td>
<td>3 (27)</td>
<td>2 (17)</td>
</tr>
<tr>
<td></td>
<td>No major disease</td>
<td></td>
<td>4 (36)</td>
<td>9 (75)</td>
</tr>
<tr>
<td>Problem recognition</td>
<td>Flock observation</td>
<td>Mortality, behavior</td>
<td>11 (100)</td>
<td>10 (83)</td>
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<tr>
<td></td>
<td>Processing</td>
<td>Trim, condemnations</td>
<td>0</td>
<td>2 (17)</td>
</tr>
<tr>
<td></td>
<td>Facility improvement</td>
<td></td>
<td>3 (27)</td>
<td>4 (33)</td>
</tr>
<tr>
<td></td>
<td>Compare other flocks</td>
<td></td>
<td>0</td>
<td>3 (25)</td>
</tr>
<tr>
<td>Information sources</td>
<td>Experience</td>
<td>Other producers</td>
<td>8 (73)</td>
<td>4 (33)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Veterinarian</td>
<td>10 (91)</td>
<td>10 (83)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hatchery agent</td>
<td>7 (64)</td>
<td>5 (42)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nutritionist</td>
<td>4 (36)</td>
<td>8 (67)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Feed salesman</td>
<td>1 (9)</td>
<td>1 (8)</td>
</tr>
<tr>
<td></td>
<td>Other sources</td>
<td>Other producers</td>
<td>2 (18)</td>
<td>6 (50)</td>
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<tr>
<td></td>
<td></td>
<td>Newspapers</td>
<td>3 (27)</td>
<td>4 (33)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Online</td>
<td>1 (9)</td>
<td>6 (50)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Courses</td>
<td>8 (73)</td>
<td>9 (75)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Magazines/journals</td>
<td>2 (18)</td>
<td>2 (17)</td>
</tr>
<tr>
<td></td>
<td>Motivation to address health issues</td>
<td>Financial</td>
<td>8 (73)</td>
<td>6 (50)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Feeling frustrated</td>
<td>3 (27)</td>
<td>4 (33)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Responsible for flock</td>
<td>6 (55)</td>
<td>7 (58)</td>
</tr>
<tr>
<td>Response</td>
<td>Manage on own with products on hand</td>
<td>Experience</td>
<td>10 (91)</td>
<td>9 (75)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conduct postmortems</td>
<td>2 (18)</td>
<td>1 (8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Facility cleaning/maintenance</td>
<td>3 (27)</td>
<td>5 (42)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vitamins, probiotics</td>
<td>5 (45)</td>
<td>5 (42)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OTC antibiotics</td>
<td>8 (73)</td>
<td>4 (33)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prescription antibiotics</td>
<td>2 (18)</td>
<td>0</td>
</tr>
<tr>
<td>Consultation</td>
<td>Veterinarian</td>
<td></td>
<td>10 (91)</td>
<td>10 (83)</td>
</tr>
<tr>
<td></td>
<td>Feed salesman</td>
<td></td>
<td>3 (27)</td>
<td>10 (83)</td>
</tr>
<tr>
<td></td>
<td>Nutritionist</td>
<td></td>
<td>1 (9)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Hatchery agent</td>
<td></td>
<td>2 (18)</td>
<td>9 (75)</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td></td>
<td>1 (9)</td>
<td>1 (8)</td>
</tr>
<tr>
<td>No treatment</td>
<td>Watchful waiting</td>
<td></td>
<td>1 (9)</td>
<td>5 (42)</td>
</tr>
<tr>
<td></td>
<td>Call</td>
<td></td>
<td>1 (9)</td>
<td>3 (25)</td>
</tr>
<tr>
<td>Barriers to consultation</td>
<td>Familiar with problem</td>
<td></td>
<td>5 (45)</td>
<td>5 (42)</td>
</tr>
<tr>
<td></td>
<td>Time/distance to lab</td>
<td></td>
<td>5 (45)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Cost of diagnostics</td>
<td></td>
<td>5 (45)</td>
<td>4 (33)</td>
</tr>
<tr>
<td></td>
<td>Time to results</td>
<td></td>
<td>3 (27)</td>
<td>1 (8)</td>
</tr>
<tr>
<td></td>
<td>Useful results</td>
<td></td>
<td>3 (27)</td>
<td>2 (17)</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td></td>
<td>1 (9)</td>
<td>1 (8)</td>
</tr>
<tr>
<td>Gaps</td>
<td>No gaps identified</td>
<td></td>
<td>5 (45)</td>
<td>8 (67)</td>
</tr>
<tr>
<td>Information to manage challenging problems</td>
<td>Early mortality/chick quality</td>
<td></td>
<td>5 (45)</td>
<td>6 (50)</td>
</tr>
<tr>
<td></td>
<td><em>Cocci/Staphylococcus</em></td>
<td></td>
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<td>0</td>
</tr>
<tr>
<td>Service</td>
<td>Antibiotics available</td>
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<td>0</td>
<td>2 (17)</td>
</tr>
<tr>
<td></td>
<td>Lack of farm visits</td>
<td></td>
<td>4 (36)</td>
<td>1 (8)</td>
</tr>
<tr>
<td></td>
<td>Not 24/7 service</td>
<td></td>
<td>1 (9)</td>
<td>1 (8)</td>
</tr>
<tr>
<td></td>
<td>Poor lab services</td>
<td></td>
<td>5 (45)</td>
<td>4 (33)</td>
</tr>
<tr>
<td></td>
<td>Poor support from hatcheries</td>
<td></td>
<td>4 (36)</td>
<td>0</td>
</tr>
<tr>
<td>Trusting relationships</td>
<td>Sharing all flock data</td>
<td></td>
<td>3 (27)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Trust in hatcheries</td>
<td></td>
<td>7 (64)</td>
<td>0</td>
</tr>
<tr>
<td>Poor communication</td>
<td>No sense of common good</td>
<td></td>
<td>2 (18)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>With hatcheries</td>
<td></td>
<td>3 (27)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Among producers</td>
<td></td>
<td>3 (27)</td>
<td>2 (17)</td>
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<tr>
<td></td>
<td>Research knowledge transfer</td>
<td></td>
<td>3 (27)</td>
<td>0</td>
</tr>
<tr>
<td>Sharing</td>
<td>Willing to share</td>
<td></td>
<td>10 (91)</td>
<td>12 (100)</td>
</tr>
<tr>
<td></td>
<td>Careful to share</td>
<td></td>
<td>7 (64)</td>
<td>10 (83)</td>
</tr>
</tbody>
</table>

OTC — Over the counter (non-prescription).
to complex and recurring diseases such as early mortality as a “disease problem,” although these were discussed later in the interview by most producers. All 4 HEPs and 7 of the 10 BP interviews that reported No major disease problems also described Challenging disease problems.

**Problem recognition.** All producers relied on experience to recognize problems in their flocks. Producers described walking the barns daily to observe the birds, looking for clues in behavior, feed and water consumption, and mortality levels to determine how birds were doing. Any deviation from expected was sought, producers relied on personal networks. Relationships with members of their personal networks were often based on trust and respect and were the product of experience over time.

Within their personal networks, many producers (n = 18, 78%) preferred talking face-to-face to other producers when managing challenging problems. However, those who were geographically more isolated found meetings difficult to attend. Work required the HEPs to remain on-farm and made it difficult to attend meetings. E-mail was the next preferred method of communicating information (n = 12, 52%), especially time-sensitive information, but others favored telephone or cell phones (n = 9, 39%); multiple methods of communication were necessary to reach all producers.

**Information sources.** Producers trusted their experience as a source of information (Table 2). When additional information was sought, producers relied on personal networks. Relationships with members of their personal networks were often based on trust and respect and were the product of experience over time.

Producers often used this information to make decisions about disease management. When producers were asked to describe the barriers to submitting birds for postmortem examination, the most common reason was the time and distance needed to travel to submit birds was a problem for 45% of the HEPs. No BPs indicated that this was an issue. The cost of diagnostic testing was identified as a barrier to submission by both groups. Some producers did not find the information from diagnostic testing helpful for making management changes. In addition, the producers would be compensated by the hatchery for increased early mortality, and this discouraged submission.

Producers also needed the information to be relevant to them and any recommendations to be feasible within their management system. Could it be implemented in their barns, was it right for them? Perhaps they would experiment with a new approach for 1 cycle and monitor the results. Some producers described waiting to hear the results from other producers who had adopted a new management technique before considering it for themselves.

**Gaps.** Producers were asked when they consider all the information sources that are available to them and the challenges they had in raising poultry, what they would identify as the gaps in information or service. Managing challenging problems, in particular bird quality, was identified by 8 (73%) of the HEPs and 6 (50%) of the BPs. Five (45%) of the HEPs and 8 (67%) of the BPs indicated that from their perspective there were no gaps. Replicas were often inconsistent with previous responses. Each of the 5 HEPs and 6 of the 8 BPs who indicated that there were no gaps in their information sources had also described experiences managing challenging disease problems that were not readily solved, the most frequently cited problem being early mortality. If probed to clarify this inconsistency, 3 HEPs and 2 BPs blamed the recent introduction of the Ross 308 bird and the chicks it produces for early mortality.

Hatching egg producers were more likely to discuss other perceived gaps in service. More on-farm visits by either a hatchery agent or veterinarian were desired by 7 (64%) of the HEPs but only 1 (8%) of the BPs. Many admitted that the cost of these services could be a deterrent (Table 2). Trust in the hatcheries was an important issue for the HEPs. Concerns were raised
about the objectivity of the information they received from the hatcheries.

Sharing. Most producers were willing to share detailed information about their flocks with other producers and agencies but it was important that there would be no negative consequences for themselves or their farms and that the group requesting the information was legitimate and could be trusted.

Discussion

While the HEPs and the BPs responded alike to many questions, there appeared to be greater challenges raising breeder birds compared with broiler birds. The HEPs had more concerns and identified additional gaps in the resources available compared with the BPs.

Most of the producers in this study had low levels of formal education but abundant practical knowledge borne of experience. Once they had detected a change and characterized a problem they again relied on their experience to determine the next steps. Knowledge was personal, context specific, subjective, and goal-oriented. To assimilate new information it needed to be incorporated with existing experience so as to be understood and to give meaning to the information. Learning from the experience of trial and error and from observing the results of innovation implemented by other producers has been described by Bandura (10). The producers wanted to understand what was going on and to find a solution to complex disease problems but described a perception that their actions may not have much impact on the outcomes. The flock placed in the next cycle could be better or more of the same. Within their personal networks other producers were describing similar challenges, which re-enforced their belief that not much could be done; it was beyond their control. Some described feeling powerless but they were not indifferent.

Producers recognized that numerous sources of information were available to them but looked toward trusted sources and institutions for guidance. Previous work has demonstrated the importance of trust for effective communication (11). The producers talked extensively about the value of the trusting relationships within their networks and the components of industry that they did not trust. Specifically, we identified the lack of confidence of the HEPs in the hatcheries as a very important barrier to sharing information.

The producers described information needs that were met and information needs that were known but not met. The contradictory responses by some producers around unsolved complex disease issues but satisfied information needs suggest there were also information needs that were either not recognized or they believed that there were no solutions within their control. Further producer consultation would be required to ensure a participatory, problem-orientated evaluation of the information needs. A meaningful participatory approach could allow producers to define their priorities in applied agricultural research and improve their uptake of research-based knowledge; this study indicates that producers would support research examining early chick mortality.

Producer participation in identifying information gaps and developing research questions supports integration of science with their knowledge into the decision-making processes (12–14). This study revealed some opportunities for enhanced collection of diagnostic data to enhance disease surveillance or to understand the epidemiology of disease. For example, reducing the cost and inconvenience of laboratory submissions and demonstrating the value of laboratory results may remove some of the barriers to submission of samples. The producers expressed a willingness to share data so it may also be feasible to integrate production data with clinical laboratory data for improved disease detection and study.

This study had limitations. It is unknown if the views expressed by the participants in this study are representative of all broiler bird producers in Alberta. The producers in this study may have modified their responses during the interview due to social desirability bias. In addition, hand-written recording of responses to interview questions may have resulted in errors and recoder bias.

References

Congenital nuclear cataracts in a Holstein dairy herd

Stephanie Osinchuk, Lyall Petrie, Marina Leis, Fritz Schumann, Bianca Bauer, Lynne Sandmeyer, Kayla Madder, Fiona Buchanan, Bruce Grahn

Abstract — This report describes congenital nuclear cataracts and posterior lenticonus in a closed purebred Holstein dairy herd in Canada. Ophthalmic examinations were completed on 30 male and 249 female cattle aged newborn to 10 years old. Nutritional, infectious, and toxic etiologies were investigated. Necropsies of 3 affected calves were performed and eyes of 2 additional affected calves were examined with light microscopy. Bilateral nuclear cataracts were identified in 53/279 (19%) animals. Additional congenital anomalies observed included posterior lenticonus, iris to lens persistent pupillary membranes (n = 7), and lenticular colobomata (n = 1). Heifers did not give birth to calves with congenital nuclear cataracts (0/105), whereas the incidence of affected calves born to multiparous cows was 31% (53/171). The animals with nuclear cataracts ranged from newborn to 8 years old. The cataracts appeared to be non- or minimally progressive. Light microscopic examination of 10 affected globes confirmed nuclear cataract with posterior lenticonus (n = 10). Pedigree analysis was inconclusive. Polymerase chain reaction and sequence analysis for the NID1 gene deletion were negative. The etiology of the congenital lenticular anomalies was not determined.


Introduction

Cataracts are focal to generalized opacities within the lens. Their influence on vision varies from inconsequential to blinding. Cataracts manifest unilaterally or bilaterally and can be congenital, developmental, or acquired; they have multiple etiologies (1). Congenital nuclear cataracts develop as a result of ocular insults occurring during early ocular organogenesis (1). In the cow, lens organogenesis occurs at approximately 17 to 45 d of gestation (2). Reported etiologies for bovine congenital cataracts include infection with bovine viral diarrhea virus (BVDV) (3), hypovitaminosis A (4,5), and genetic mutations (6–9). Recently, oxidative stress has been speculated to play a role (10).

Infection with BVDV between 75 and 150 d gestation has been associated with congenital equatorial and subcapsular cataracts (3). Affected calves have mucosal disease and...
the primary ocular manifestations can include uveitis, retinal degeneration, and optic neuritis, although cataracts are also reported (3). Inherited congenital cataracts in the Holstein, Jersey, and Romagnola have been reported as an autosomal recessive condition (6–9). In Romagnola cattle, the mutation has been identified as a deletion in the NID1 gene (9). Congenital ocular anomalies and cataracts also develop following prolonged maternal hypovitaminosis A (4,5). Primary vitamin A deficiency can develop when cattle are fed a ration containing little or no green forage without supplementation (11) and when expired supplements are fed (4). Congenital nuclear cataracts have also been reported in cattle on farms with a history of vitamin E deficiency or with low levels of selenium in their feed (12).

An increase in congenital nuclear cataracts was reported on a Swiss dairy farm following the installation of a mobile phone base station (MPBS) in the vicinity (13). Distance to MPBS has been associated with increased markers for oxidative stress in aqueous humor of globes collected from Swiss veal calves at slaughter (14). Globes with cataract had increased oxidative stress (14). It has not been shown that mobile telephone antennas affect stress or cause congenital nuclear cataract (14).

This is the first report describing congenital nuclear cataracts and posterior lenticous in a closed purebred Holstein dairy herd in Canada.

Materials and methods

In November 2014 a dairy farmer reported the birth of 3 calves with “white eyes” to a field service veterinarian at the Western College of Veterinary Medicine who diagnosed congenital cataracts. The herd (n = 279) was screened by a veterinary ophthalmologist in scotopic conditions with a transilluminator. Complete ophthalmic examinations were conducted on all animals with leucocoria (n = 56) following dilation with 0.5% Tropicamide (Mydriacyl; Alcon Canada, Mississauga, Ontario). These included neuro-ophthalmic examinations, biomicroscopy, and indirect ophthalmoscopy. The only bull calves that were examined were those born since January 2015. Data from birth month and cow parity were collected and analyzed using 95% confidence intervals (CI). Feed samples were submitted for analysis and testing for mycotoxins. Water was submitted for analysis. Skin biopsies of affected animals were submitted for immunohistochemical detection of BVDV. The vaccine and medical histories for the herd were reviewed. Teratogen exposure was reviewed carefully with the owner. Distance to the nearest MPBS was calculated.

Light microscopic examinations were completed on 10 formalin-fixed globes from 5 affected calves. Complete necropsy examinations were completed on 3 affected calves. Fresh liver samples were submitted for vitamin A, iron, copper, and selenium levels. Blood samples were collected through coccygeal venipuncture and DNA was harvested from white blood cells. The DNA from affected and non-affected animals was evaluated for a deletion mutation in the NID1 gene, using previously published methods (8).

Results

Ophthalmic examinations

Nuclear cataracts were confirmed in 53/279 (19%) animals. In animals with smaller nuclear cataracts, biomicroscopic examination allowed for visualization of posterior lenticous. Extensive nuclear to posterior cortical cataracts prevented visualization of the posterior lens in many cases, precluding the establishment of an n value for posterior lenticous. Other abnormal ophthalmic findings in the herd included: iris to lens persistent pupillary membranes with associated anterior capsular cataract (PPMs, n = 7), incipient capsular cataracts (n = 8), and lenticular colobomata (n = 1).

The nuclear cataracts varied in size and opacity (Figures 1, 2). The anomalies were present in animals that were examined at birth. Younger animals were the most visually impaired as the cataract occupied most of the lens and extended to the periphery. Affected older cows had clear cortical fibers around the affected nucleus. Most animals were bilaterally affected although the lesions were not always symmetrical. Only bull calves from the current year were examined. The use of artificial insemination in this herd precluded examination of any herd sires.

Prevalence/incidence

The prevalence of congenital nuclear cataracts in the herd was 19%. Heifers did not produce calves with cataracts (0/105; Figure 3). The incidence in calves born to cows in their second or higher parity was 31% (53/171; Figure 3). Examination of the breeding records demonstrated use of the same bulls in both heifers and multi-parity cows. Bull calves and heifer calves were equally affected. The average number of affected calves born per
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fed a hay-based diet until 3 wk before calving. In the 3 wk prior to calving they were fed a total mixed ration with a custom close-up supplement formulated by Dairy Smart. Calves were fed a milk-based diet. After weaning, heifers were fed a silage-based diet supplemented with a custom 16% protein heifer grower pellet made by Dairy Smart. Near infrared spectroscopy and wet chemical analysis was completed for the total mixed ration fed to the lactating and pregnant cows. Nutrients were within normal limits (Table 1). Water was sourced from a well and analysis was within normal limits (data not shown). Mycotoxin analysis was within normal limits (data not shown).

Table 1. Analyses of total mixed ration (TMR) demonstrating nutrient values were within recommended limits

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Current analysis</th>
<th>Recommended minimum</th>
<th>Maximum tolerable level (19)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium (% DM)</td>
<td>1.03</td>
<td>0.67</td>
<td>Not listed</td>
</tr>
<tr>
<td>Phosphorus (% DM)</td>
<td>0.41</td>
<td>0.36</td>
<td>1.00</td>
</tr>
<tr>
<td>Magnesium (% DM)</td>
<td>0.35</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Potassium (% DM)</td>
<td>1.69</td>
<td>1.06</td>
<td>3</td>
</tr>
<tr>
<td>Sulfur (% DM)</td>
<td>0.31</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Sodium (% DM)</td>
<td>0.43</td>
<td>0.22</td>
<td>1.6</td>
</tr>
<tr>
<td>Chloride (% DM)</td>
<td>0.66</td>
<td>0.28</td>
<td>4</td>
</tr>
<tr>
<td>Iron (mg/kg)</td>
<td>356</td>
<td>17</td>
<td>1000</td>
</tr>
<tr>
<td>Manganese (mg/kg)</td>
<td>68</td>
<td>13</td>
<td>1000</td>
</tr>
<tr>
<td>Zinc (mg/kg)</td>
<td>107</td>
<td>52</td>
<td>300 to 1000</td>
</tr>
<tr>
<td>Copper (mg/kg)</td>
<td>39</td>
<td>11</td>
<td>40</td>
</tr>
<tr>
<td>Selenium (mg/kg)</td>
<td>0.52</td>
<td>0.3</td>
<td>5b</td>
</tr>
<tr>
<td>Vitamin A (IU/kg)</td>
<td>26 154</td>
<td>2780</td>
<td>66 000c</td>
</tr>
</tbody>
</table>

* Based on 45 kg milk production (19).
* Level at which chronic selenium toxicity may occur.
* Presumed safe limit for vitamin A.

month in 2015 was 2 (range: 0 to 5). Analysis of birth month for all affected animals demonstrated an increased incidence of affected animals born in June; however, when analyzed using a 95% CI the incidence overlapped with other months (Figure 4). The oldest affected animal in the herd was born in 2008.

Environment
The herd consisted of approximately 280 Holstein cattle. Approximately 100 milking cows were housed in a tie stall barn and the remaining cows and bred heifers were housed in a dry lot. The barns were bedded with straw. Calves were housed in individual pens in a calf barn. Heifer calves were retained in the herd and bull calves were sold at a few months of age. Artificial insemination was used exclusively. The nearest MBPS was 11.6 km away.

Diet and feed/water analysis
Lactating cows were fed a total mixed ration which consisted of barley silage, canola meal, soybean meal, corn distillers, canola oil, monensin, and a custom vitamin/mineral premix (Dairy Smart, Saskatoon, Saskatchewan). Dry cows and heifers were fed a hay-based diet until 3 wk before calving. In the 3 wk prior to calving they were fed a total mixed ration with a custom close-up supplement formulated by Dairy Smart. Calves were fed a milk-based diet. After weaning, heifers were fed a silage-based diet supplemented with a custom 16% protein heifer grower pellet made by Dairy Smart. Near infrared spectroscopy and wet chemical analysis was completed for the total mixed ration fed to the lactating and pregnant cows. Nutrients were within normal limits (Table 1). Water was sourced from a well and analysis was within normal limits (data not shown). Mycotoxin analysis was within normal limits (data not shown).

History
The average milk production was 37 kg/cow per day. Vaccinations for clostridia, infectious bovine rhinotracheitis and BVDV were provided annually over the preceding 10 y. Historical review of the medical record revealed no associated medical disorders and no previous incidents of any other congenital anomalies.

Other tests
Immunohistochemistry tests for BVDV in skin biopsies from 7 affected animals were negative. Discussion with the herd manager and examination of the premise revealed no sources of teratogens. Polymerase chain reaction and sequence analysis for the NID1 deletion were negative. Ten globes from 5 affected calves were submitted for histological analysis. All calves had bilateral posterior lenticous, and nuclear and posterior cortical cataracts (Figure 5).

Postmortem examination
Three affected calves were submitted for complete necropsy. One calf had mild omphalitis and another calf had a patent foramen ovale, both of which were considered incidental. The third calf had no systemic abnormalities. The liver values for vitamin A, magnesium, manganese, cobalt, zinc, molybdenum, selenium, copper, and iron in all 3 calves were within normal limits.

Pedigree analysis
Pedigree analysis was conducted for the cows and calves in the herd. Ocular phenotypes of the sires were unknown. Dams of 43 affected animals were available for examination, 37 were...
normal and 6 were affected. There were 6 incidences in which 3 consecutive generations were examined. In 2 of these incidences the grand dam was normal and the cow and calf were affected. In the remaining 4 incidences the grand dam and dam were normal and the calf was affected. There were 6 sets of twins in the herd, 4 sets in which both calves were affected, 1 set in which both calves were normal and 1 set in which 1 was affected and the other was normal. Both male and female calves were equally affected in 2015. Affected animals were sired by 27 different bulls and could be traced back to the same ancestral bull (not shown in herd pedigree). In most cases this bull was present in both the maternal and paternal lineage and was typically 5 to 8 generations prior to the affected animal. Pedigrees with this level of inbreeding would typically suggest a recessive inheritance; however, at the time of publication an inheritance pattern could not be clearly demonstrated.

**Discussion**

Congenital nuclear and posterior cortical cataracts and posterior lenticonus are reported in a Canadian Holstein dairy herd. These cataracts were similar to those observed in other reports in which etiologies were not determined (10,12,13,15). Similar to our findings, previous authors also reported a lower incidence of lesions in calves born to heifers (10,12,15). These authors speculated that lactation plays a role in the development of cataracts. Derom (10) reported butyric acid was elevated and total protein was decreased in dams of affected calves. Blood butyric acid can originate from rumen fermentation of feed, or directly from silage, or is produced as a byproduct of fat metabolism (17). A difference in butyric acid level would be expected between lactating multiparous cows and non-lactating heifers. A comparison of these variables between multiparous cows with normal calves and multiparous cows with affected calves was not reported. Low serum selenium and glutathione peroxidase were also reported (10). In 1 report a history of vitamin E and feed selenium deficiencies were identified (12). The authors speculated that low antioxidants (selenium and vitamin E) contributed to a reduction/oxidation imbalance leaving the developing lens vulnerable to oxidative damage. In our investigation, the selenium levels in the total mixed ration (TMR) fed to lactating cows, and selenium levels measured in the livers of 3 affected calves were within normal limits. Serum selenium and glutathione were not measured.

There was a higher incidence of affected animals born in the month of June (conceived in September), but a 95% CI overlapped with intervals from other months. Two reports identified an increase in incidence of affected calves conceived and undergoing organogenesis in the fall and winter months (12,16); however, no statistical analyses were done on these herds. The herds were managed on grass in spring and summer and were switched to winter feed in the fall. The change from grazing to winter feed early in lactation coincided with an increased incidence of cataracts in calves (12,16). Ellis and Bilsson (12) did, however, note that the silage used in the winter feed was unlikely the problem as it was also fed to the heifers which did not have affected calves. The cows in our investigation were fed TMR year-round with no access to pasture. Further investigation into the relationship between grazing and disease incidence is required.

Hereditary congenital cataracts have previously been reported in Jerseys, Holstein-Friesians, and Romagnola cattle (6,8,9,18). Reports of hereditary congenital cataracts in Holstein-Friesians and Jerseys included microphakia and buphthalmos (6,8), which were not observed in our investigation. The lesions caused by a *NID1* deletion mutation described in Romagnola cattle (9) were phenotypically similar to the lesions observed in our herd; however, the *NID1* deletion mutation was not present in our herd. Pedigree analysis revealed a high level of inbreeding, which is reflective of common industry practices. There was a similar distribution of affected animals between male and female calves. On one occasion a cow gave birth to twins and 1 calf was affected while the other was normal. The lack of affected calves born to heifers despite shared sire use with multiparous cows makes a simple autosomal inheritance less likely, and a multifactorial etiology more likely.

Prolonged maternal hypovitaminosis A is associated with outbreaks of severe congenital ocular anomalies in calves (4,5). These include ocular dermoids, microphthalmias, and retinal dysplasia but not cataracts (4,5). In this study, hypovitaminosis A was ruled out as feed and liver levels of vitamin A were within normal limits. Liver and blood levels of vitamin A in gestating cows were not evaluated.

In this investigation PPM’s in 7 animals and lenticular colobomata in 1 cow were considered incidental findings. Previous authors did not report either of these anomalies in their investigations.
Teratogenic and other infectious etiologies for congenital nuclear cataracts and posterior lenticonus were excluded based on the high health of the herd, examination of the premise, and questioning of the farmer. No other congenital anomalies were observed in the herd throughout the course of the investigation. The distance between the farm and the nearest mobile phone antenna made it unlikely that the antennas contributed to the incidence of cataract. The animals were housed either in a tie stall stanchion or in a dry lot with limited environmental variation. Sources of teratogens would be limited to feed contamination or be iatrogenic from undocumented treatments. These sources were considered unlikely. These methods do allow for a margin of error and it is impossible to conclusively rule out all teratogens or infectious agents.

In conclusion, congenital nuclear cataracts and posterior lenticonus were observed in a Canadian Holstein dairy herd. Known nutritional, infectious, and toxic causes were ruled out. We suggest that these particular abnormalities could be due to genetics, oxidative stress, or possibly a combination of the 2; however, the etiology remains undetermined.

Acknowledgment

Funding for this project was provided through Saskatchewan Agriculture.

References

Ovarian carcinomatosis in a dog managed with surgery and intraperitoneal, systemic, and intrapleural chemotherapy utilizing indwelling pleural access ports

Matthew P. Best, Angela E. Frimberger

Abstract — A 3-year-old Weimaraner dog was presented with bilateral papillary ovarian carcinoma and abdominal carcinomatosis. Treatment included ovariectomy, intraperitoneal cisplatin, and systemic carboplatin. Pleural carcinomatosis 473 days following surgery was treated with intrapleural cisplatin through indwelling pleural access ports. Euthanasia occurred 1154 days following surgery due to malignant pleural effusion without peritoneal effusion.

Résumé — Carcinomatose ovarienne chez une chienne gérée par chirurgie et chimiothérapie intrapleurale, systémique et intrapéritonéale en utilisant des ports d’accès à demeure. Une chienne Weimaraner âgée de 3 ans a été présentée avec un carcinome papillaire bilatéral et une carcinomatose abdominale. Le traitement a inclus l’ovariectomie, de la cisplatine intrapéritonéale et de la carboplatine systémique. Une carcinomatose pleurale 473 jours après la chirurgie a été traitée avec de la cisplatine intrapleurale par des ports d’accès pleuraux à demeure. L’euthanasie a été réalisée 1154 jours après la chirurgie en raison d’une effusion pleurale maligne sans épanchement péritonéal.

(Traduit par Isabelle Vallières)

Ovarian neoplasia is rare in modern companion canine populations due to the high incidence of ovariectomy/ovariohysterectomy (1). In populations of entire female dogs it has been estimated that the prevalence of ovarian neoplasia is 6.25% (2). Of these cases approximately 50% are epithelial in origin and 64% of those that are epithelial in origin are malignant (3). In 1 study, 10 of 18 dogs with ovarian adenocarcinomas had metastatic disease, with local carcinomatosis being the most common metastatic manifestation (3).

There is no established standard treatment for canine ovarian carcinoma with regional metastasis (carcinomatosis) (1) and in many cases dogs are euthanized due to a perceived poor prognosis (4,5). In humans ovarian neoplasia is the second most common gynecological cancer and most patients have a high clinical stage of disease at presentation and a poor prognosis for long-term survival (6). The standard of care for human ovarian adenocarcinoma is cytoreduction of gross disease to < 1 cm thickness followed by the use of combination chemotherapy with a platinum compound and paclitaxel (6–8).

Case description

A 3-year, 3-month-old female intact Weimaraner dog was presented with a 5- to 6-day history of abdominal distension without change in demeanor or appetite. On examination, there was marked abdominal distension with a fluid wave and the rest of the examination was unremarkable. Abdominal sonography revealed a large volume effusion and bilateral ovarian masses. The left ovary was partially cavitated and measured 5.3 × 2.6 cm (Figure 1) while the right was homogenous and smaller, measuring 3.9 × 2.0 cm (Figure 2). Cytology of both the abdominal fluid and the ovarian masses was consistent with carcinoma. Thoracic radiographs were unremarkable as was an echocardiogram. A comprehensive biochemistry panel and a complete blood cell count were within normal limits.

On exploratory laparotomy 5 L of serosanguinous fluid were drained from the abdomen. The peritoneum was grossly thickened with widespread erythematous and nodular changes. The uterus was adhered to the colon and there was marked mesenteric lymphadenopathy, with the largest nodes estimated to have a maximum cross-sectional thickness of 10 to 20 mm. The bilaterally enlarged ovaries were removed via ovariectomy but rigorous resection of the generalized regional metastatic disease was not anatomically feasible. Histopathology confirmed bilateral ovarian papillary carcinoma with extensive vascular and lymphatic infiltration. The diagnosis of carcinomatosis was based on the clinical presentation, the gross appearance, the
presence of carcinoma cells within the effusion, and extensive vascular infiltration on histology.

Three weeks following surgery urine culture was negative and serum creatinine was normal; further urinalysis was not performed. A blood smear was evaluated at this time with no abnormalities noted in abundance or morphology of any cell line. Abdominal sonography showed small amounts of generalized free fluid and a mildly irregular renal outline while the residual disease seen at surgery could not be identified. For 4 h prior to intraperitoneal (IP) treatment saline diuresis was performed with 18.3 mL/kg body weight (BW) per hour of intravenous saline (0.9% NaCl) solution. Pretreatment antiemetics were administered with maropitant (Cerenia; Zoetis, Silverwater, NSW, Australia), 1 mg/kg BW, SC 4 h prior to chemotherapy and 2 doses of butorphanol (Torbugesic; Zoetis) 0.4 mg/kg BW, IM, 4 h and 10 min prior to chemotherapy. An 18 G rigid IV catheter was placed through the surgically prepared ventral midline with the dog in lateral recumbency. A solution of cisplatin (DBL Cisplatin; Hospira Australia, VIC, Australia) was prepared in 1 L of room temperature 0.9% NaCl using a closed system transfer device (PhaSeal, Becton, Dickinson and Company, New Jersey, USA) to a total dose of 70 mg/m². No fluid was removed before instillation of this solution into the peritoneal space over 5 to 10 min. The dog was rolled back and forth repeatedly, to distribute the fluid, then was briskly walked for another 2 h of saline diuresis. On all occasions the intracavitary chemotherapy was tolerated without any apparent discomfort or nausea.

Complete blood cell counts showed a normal leukogram on day 7, and uncomplicated Veterinary Co-operative Oncology Group — Common Terminology Criteria for Adverse Events (VCOG-CTCAE) grade 3 (9) neutropenia ($10^9$/L) and 14 d following the second treatment. Following 300 mg/m² carboplatin an uncomplicated VCOG-CTCAE grade 4 neutropenia ($0.45 \times 10^9$/L) was identified on day 16. Further doses were reduced to 225 mg/m² without further neutropenia. Uncomplicated VCOG-CTCAE grade 2 thrombocytopenia was noted at 16 d following the first treatment ($75 \times 10^9$/L; RI: 175 to 500 $\times 10^9$/L) and 14 d following the second treatment ($92 \times 10^9$/L). No platelet count was done after the third dose.

Brief abdominal sonograms at the time of the third dose of peritoneal cisplatin as well as the second and third doses of systemic carboplatin showed no evidence of free abdominal fluid. Monthly comprehensive abdominal sonography was performed for 3 mo following completion of the course of carboplatin and showed a very small volume of free abdominal fluid (on both occasions a single pocket of fluid measuring less than 1 $\times$ 1 cm) initially, which was undetectable by 3 mo following chemotherapy. In total, 15 abdominal sonograms were performed following completion of the initial course of chemotherapy, with the maximum period between imaging being 207 d. No sonograms identified peritoneal-free fluid or mesenteric lymphadenopathy for the remainder of the patient’s life, with the last abdominal imaging performed 1112 d after surgery.

At 473 d post-surgery the dog was presented with a recent history of expiratory wheeze. While an abdominal sonogram was normal at this time a bilateral pleural effusion was identified sonographically and was confirmed radiographically. No mass effect or nodular pattern was identified with either imaging modality. Thoracocentesis was performed and 560 mL of serosanguinous fluid was obtained. Fluid submitted for cytology showed malignant epithelial cells similar in morphology to cells in the previous carcinomatosis and consistent with a high probability of progressive disease.

Three doses of IV carboplatin (DBL Carboplatin; Hospira Australia) were given at 3-weekly intervals starting 26 d after the last intracavitary chemotherapy. Complete blood cell counts and serum creatinine levels were monitored before each dose and at 1 and 2 wk after treatment. Following 300 mg/m² carboplatin an uncomplicated VCOG-CTCAE grade 4 neutropenia ($0.45 \times 10^9$/L) was identified on day 16. Further doses were reduced to 225 mg/m² without further neutropenia. Uncomplicated VCOG-CTCAE grade 2 thrombocytopenia was noted at 16 d following the first treatment ($75 \times 10^9$/L; RI: 175 to 500 $\times 10^9$/L) and 14 d following the second treatment ($92 \times 10^9$/L). No platelet count was done after the third dose.

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Thirty-two days later intrapleural cisplatin therapy was initiated. Serum creatinine was within normal limits and urine sediment was inactive with a negative culture and a specific gravity of 1.026. Treatment with saline diuresis and maropitant was performed,
as previously, while butorphanol was not administered. Bilateral indwelling pleural access ports (Canine PleuralPort; Norfolk Vet Products, Illinois, USA) were placed under general anesthesia. Effusion was drained through the ports; the volume was not recorded but was sonographically similar to the initial pleural effusion. Intrapleural chemotherapy was then performed under the same general anesthesia with a total dose of 52.5 mg/m² cisplatin divided into 2 volumes of 125 mL/m² of 0.9% NaCl each instilled into 1 hemithorax, using Huber needles (PosiGrip 22G Huber needle; Norfolk Vet Products, Skokie, Illinois, USA) to access the indwelling pleural ports. The patient was rocked following drug instillation and, following recovery from anesthesia, was taken outside for a brisk walk to aid drug distribution within the thoracic cavity.

VCOG-CTCAE grade 1 inappetence occurred during the first week after intrapleural cisplatin. Complete blood cell counts were monitored at weekly intervals for 3 wk with no myelosuppression noted. Two further doses of intrapleural cisplatin were given at 3-week intervals, without anesthesia but otherwise following the same protocol. Thoracocentesis was also performed on these occasions with 310 mL and 410 mL removed from the left hemithorax and no effusion noted on the right. While no adverse effects were noted, a self-limiting episode of presumed unrelated infectious tracheitis was diagnosed at an emergency clinic 10 d after the second dose.

A fourth dose of intrapleural cisplatin was intended but VCOG-CTCAE grade 1 azotemia developed (creatinine 172 mmol/L; RI: < 159 mmol/L), with concurrent urine specific gravity of 1.027, after a total cumulative cisplatin dose of 385 mg/m². As thoracic and abdominal sonograms demonstrated no evidence of disease at this time, cisplatin was discontinued. Consideration was given to using further cycles of IV carboplatin as had been done previously. The dog tolerated IV carboplatin well at that time and renal function was normal; however, as carboplatin is renally excreted, it was considered that risk of side effects was now higher. Therefore considering the remission status, the potential for risk was considered greater than the potential for benefit and no further chemotherapy was administered at this time.

Monitoring by thoracic and abdominal sonography and aspiration via the ports showed no evidence of disease at rechecks 231 and 438 d following the first dose of intrapleural cisplatin.

At 607 d following the first pleural cisplatin the patient was presented with a 2-week history of lethargy, increased respiratory effort, reduced appetite, and coughing. Abdominal sonography showed no evidence of malignancy but thoracic radiographs showed left-sided effusion. Aspiration yielded 450 mL of fluid from the left hemithorax which cytologically revealed large numbers of neoplastic epithelial cells consistent with metastatic ovarian carcinoma. Repeated aspiration was required at 2- to 7-day intervals with similar volumes returned.

Twelve days following recurrence, creatinine was 164 mmol/L and 225 mg/m² carboplatin was administered into the left hemithorax in 250 mL of 0.9% NaCl through the indwelling pleural access port. Following a short improvement in clinical signs thoracocentesis was required at 15 and 18 d with 520 mL and 548 mL removed from the left hemithorax, respectively. Uncomplicated VCOG-CTCAE grade 3 neutropenia (1.07 × 10⁹/L) and uncomplicated VCOG-CTCAE grade 4 thrombocytopenia (17 × 10⁹/L) were identified on day 15.

After 3 wk, a second dose of carboplatin was given in the left hemithorax at a reduced dose of 180 mg/m². The effusion recurred after 1 wk and the patient was euthanized 1154 d after the date of the ovariectomy.

Discussion

Previously reported treatments for canine ovarian carcinoma are mostly limited to surgical resection of gross tumor tissue (1,3,4,10,11). Treatment of high-stage ovarian carcinoma in dogs with IP chemotherapy has been reported very rarely (10,12), with reports of only 3 cases of carcinomatosis treated in this way, only 1 of which was confirmed ovarian adenocarcinoma (10).

In 1 case a multi-agent systemic chemotherapy protocol containing cyclophosphamide, chlorambucil, and nitrosourea, resulted in at least 10 mo remission (13). In the single case of IP cisplatin as a treatment of canine ovarian carcinoma a second look celiotomy soon after 5 treatments of IP cisplatin suggested a complete remission, but the dog died acutely of hemoaobdenia 2 mo later (10). Another study retrospectively reviewed the use of intracavitary carboplatin and/or mitoxantrone in dogs with carcinomatosis, sarcomatosis, or mesothelioma; however, there were no cases of ovarian carcinoma or peritoneal effusion (14).

While the evidence in veterinary medicine regarding intracavitary chemotherapy is sparse, this treatment remains part of the standard of care for high stage ovarian carcinoma in human medicine and accordingly there has been extensive research into maximizing its efficacy. Experimental animal research (15,16) and human trials (6,7,17,18) demonstrate the benefits of IP cisplatin therapy over IV chemotherapy in abdominal carcinomatosis. Cisplatin has been demonstrated to penetrate into the tissue to a greater depth than carboplatin when given as an IP dose (19) and for this reason cisplatin was selected for intracavitary chemotherapy in this case. Despite this, the penetration of cisplatin is only a few millimeters (15) limiting its use as a sole therapy. Several techniques have been developed to combat this problem including cytoreductive surgery prior to chemotherapy (6,8,20), the use of IV chemotherapy following IP treatment including cisplatin (21), and measures to increase the penetration of the cisplatin including hypotonic carrier fluids (22), instillation of adrenaline in the carrier fluids (23), regional hyperthermia (23–25), use of IV sodium thiosulfate to reduce systemic side effects and so allow the use of a higher IP dose (26), and high pressure abdominal lavage (27). To date none of these have been investigated in dogs. Reducing disease to < 1 cm rather than < 2 cm would intuitively be expected to be more efficacious; however, while this is suggested in some studies, a conclusive benefit has not been demonstrated (8).

In our case cytoreduction was performed but residual disease exceeded the recommended maximum thickness in human medicine of 1 cm, although it was less than a previously used cut-off of 2 cm for optimal cytoreduction (7,8). In 1 randomized study in humans there was a significant benefit to the use...
of IV cisplatin with cytoreduction to a maximum diameter of 2 cm (18). For this reason a combination of IP cisplatin followed by carboplatin IV was used to address the need for deeper tissue penetration resulting from suboptimal cytoreduction. It was not clear whether the addition of IV therapy was necessary and it is possible that the IP cisplatin reduced the tumor burden to the extent that complete penetration became possible during later treatments. Previous studies in humans have suggested that 5 or 6 cycles of platinum chemotherapy may be as effective as 10 or 12 cycles (28,29). In this case the initial protocol of 7 cycles allowed a short course of each IP and IV chemotherapies and kept the total number of treatments similar to these studies (28,29). Indeed the presumed recurrence of disease within the pleural space was controlled for 607 d with just 3 doses of intracavitary cisplatin, although it is not known whether this would have been the best possible outcome. The protocols used were tolerated extremely well clinically, though dose reductions were required for both drugs due to asymptomatic neutropenia with cisplatin and asymptomatic neutropenia and thrombocytopenia with carboplatin. This is of particular interest because a perceived high morbidity of intracavitary cisplatin in humans has reduced its uptake by oncologists (7).

This case also highlights potential use of pleural access devices for chemotherapy drug administration as well as symptomatic/palliative thoracocentesis with the ports remaining fully functional and without adverse effects for 649 d. The use of pleural access ports has previously been described in the veterinary literature (30) and these ports are reported by the manufacturer to be indicated for administration of chemotherapy agents (31). To our knowledge functional ports have not been reported for this duration in dogs and their use for intra-pleural chemotherapy has not been described in peer-reviewed veterinary literature prior to this article.

There is no well-established survival time for ovarian carcinoma in dogs, though the prognosis is considered poor in cases with metastatic disease (1). The outcome in this case compares favorably with average survival times for high-stage ovarian carcinoma in humans (6,17,18,20). This case demonstrates long-term resolution of a peritoneal malignant effusion with surgery and intracavitary and systemic chemotherapy and a long-term (607 d) remission from a malignant pleural effusion with intracavitary chemotherapy alone. It can only be speculated as to whether or not longer remission of the thoracic component of the disease could have been achieved if renal compromise had not curtailed the course of intraperitoneal cisplatin.

This case demonstrates the potential for long-term responses to intracavitary chemotherapy and may provide encouragement to clinicians in the face of otherwise sparse information in the literature regarding the management of ovarian carcinomaomatosis. Canine ovarian carcinoma with carcinomaomatosis should be considered a disease for which there may be reasonable palliative options. Further study is needed to define case selection and treatment protocols to optimize the role of intracavitary chemotherapy in canine carcinomaomatosis. This case report also highlights the potential for indwelling pleural access ports to be used as a convenient and safe method to administer chemotherapeutic agents.

Healthy products

New Products
Nouveaux produits

Purina Launches Neurologic Breakthrough in Canine Nutrition

Thousands of dogs with idiopathic epilepsy may soon benefit from Purina’s introduction of the first and only therapeutic diet indicated to help nutritionally manage dogs with this condition as an adjunct to veterinary therapy.

Purina® Pro Plan® Veterinary Diets NC NeuroCare™ is formulated with medium chain triglyceride (MCT) oil to help nutritionally manage dogs with epilepsy that are also being administered anti-epilepsy drugs (AEDs). The diet is enhanced with a unique blend of nutrients — eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), antioxidants and B vitamins, as well as MCT oil — to help nutritionally manage dogs with cognitive dysfunction syndrome (CDS).

Idiopathic epilepsy is the most commonly diagnosed neurological disorder in dogs.1 Unfortunately, the reality for many affected dogs — and owners — is living with debilitating, uncontrolled seizures and/or unpleasant medication side effects.

“More than two-thirds of dogs with epilepsy continue to have seizures long-term, despite treatment,”2 and 20–30 percent of affected dogs remain poorly controlled,”3,4 explains Jason Gagné, DVM, DACVN, Director, Veterinary Technical Marketing for Purina Pro Plan Veterinary Diets. Meanwhile, medications such as phenobarbital and potassium bromide are commonly associated with such side effects as polyphagia, weight gain, polydipsia, polyuria, sedation, restlessness, lethargy and ataxia. The result: only four percent of veterinarians surveyed reported being either “totally” or “mostly” satisfied with current treatment options.1


Glucose serves as the primary fuel for the brain; however, brain glucose metabolism is compromised in patients with epilepsy, creating a need for an alternate source of brain energy. According to Dr. Gagné, adding ketones as an energy source for the brain is an approach that has been used for decades in children with epilepsy;6 however, the human “ketogenic” diet, which is high in fat and low in protein and carbohydrates, has yet to be shown to significantly improve seizures in dogs as it does in humans.7

Fortunately, dogs can readily metabolize medium chain triglycerides (MCTs) to produce ketones.8 Experts also believe that dietary MCTs may have direct antiseizure effects via blocking the Alpha-Amino-3-Hydroxy-5-Methyl-4Isoxazolepropionic Acid (AMPA) receptors in the brain.9

A six-month randomized placebo-controlled, double-blinded crossover study conducted in dogs with idiopathic epilepsy at the Royal Veterinary College in London, in partnership with Purina, demonstrated for the first time that a diet with MCT oil can have positive effects on reduction of seizure frequency when fed as an adjunct to veterinary therapy.8 Results included:
• 71% of dogs showed a reduction in seizure frequency
• 48% of dogs showed a 50% or greater reduction in seizure frequency
• 14% of dogs achieved complete seizure freedom

Based on this information, Purina developed its NeuroCare diet, formulating it with MCT oil. Dr. Gagné notes that NeuroCare is formulated with lower amounts of fat and higher proportions of protein and carbohydrates than the traditional human ketogenic diet. “This provides for a complete and balanced diet — which is important, given that epileptic dogs need to be on this specialized diet for the remainder of their lives,” he explains.
Femoral head ostectomy and medial patellar ligament desmotomy to treat a pregnant miniature horse with coxofemoral joint luxation and upward fixation of the patella

Elsa K. Ludwig, Christopher R. Byron

Abstract — A 2-year-old, 8-weeks pregnant, non-weight bearing miniature horse mare was treated for a 6-day-old left coxofemoral joint luxation with a femoral head ostectomy. The procedure had no negative effects on pregnancy or parturition and 23 months following surgery the horse had minimal lameness.

Résumé — Ostectomie de la tête fémorale et desmotomie du ligament patellaire médial pour traiter une jument miniature gravide atteinte d’une luxation de l’articulation coxofémorale et d’une fixation supérieure de la rotule.

Une jument miniature non portante gravide de 8 semaines et âgée de 2 ans a été traitée pour une luxation de l’articulation coxofémorale gauche datant de 6 jours à l’aide d’une ostectomie de la tête fémorale. L’intervention n’a pas eu d’effets négatifs sur la gestation ou la parturition et 23 mois après la chirurgie, la jument présentait une boiterie minime.


Case description

A 2-year-old, 113 kg, miniature horse mare that was approximately 8 wk pregnant was referred to the large animal hospital at the Virginia-Maryland College of Veterinary Medicine (VMCVM) Veterinary Teaching Hospital (VTH) because of non-weight bearing left hind limb lameness. The owners found the mare non-weight bearing on that limb in a paddock 6 d before presentation at the VMCVM hospital. Initially, the mare had been admitted to another large animal hospital, where the horse was diagnosed with a luxated left coxofemoral joint. Four days before the mare arrived at the VMCVM hospital, 5 unsuccessful attempts at closed reduction of the left coxofemoral joint under general anesthesia had been performed at the other large animal hospital. The mare's lameness did not improve following attempted closed reduction of the coxofemoral joint, and the owners elected to bring the horse to the VMCVM hospital for further assessment.

Physical examination at the time of arrival at the VMCVM VTH revealed that the mare had a non-weight bearing lameness of the left hind limb with upward fixation of the patella in that limb. The mare would not place the foot down when ambulating, and would toe-touch when non-ambulatory. The mechanical lameness caused by the upward fixation of the patella made assignment of the lameness grade difficult, but it was estimated at AAEP grade 4/5 (1). The left hind limb was rotated externally and there was moderate edematous swelling of the hock and mild distal limb edema. The cause of the moderate limb swelling was unknown, but could have been attributed to prior limb manipulation or dependent edema secondary to the coxofemoral joint luxation. The right and left hip joint regions were asymmetric in appearance and the greater trochanter of the left femur was displaced proximally (as determined via palpation). No crepitus was palpated when the left coxofemoral joint was manipulated. The remainder of the physical examination was unremarkable. A transabdominal ultrasound examination revealed no abnormalities of the pregnancy. Standing radiographs of the pelvis (laterolateral and lateral-oblique projections) were obtained with the mare unsedated and a diagnosis of craniodorsal luxation of the left coxofemoral joint was made (Figure 1).

Due to the 6-day duration of the coxofemoral joint luxation and previous failure at closed reduction, the owners elected to have a femoral head ostectomy procedure performed for the mare. Financial limitations of the owners dictated the need for a surgical procedure that could be performed relatively rapidly and did not require extensive follow-up care. Additionally, left medial patellar ligament desmotomy was planned for the correction of upward fixation of the patella. Perioperative and postoperative antimicrobial and anti-inflammatory medications were administered. Potassium penicillin G (Pfizerpen; Pfizer, New York, New York, USA), 22 000 IU/kg body weight (BW), IV, q6h, and gentamicin (Sparhawk Laboratories, Lenexa, Kansas, USA), 6.6 mg/kg BW, IV, q24h were administered for 3 d, followed by sulfamethoxazole-trimethoprim (Aurobindo Pharma USA, Cranbury, New Jersey, USA), 30 mg/kg BW, PO,
Phenylbutazone liquid (MWI/VetOne, Boise, Idaho, USA), 4.4 mg/kg BW, IV, q12h was also administered for 5 d, then phenylbutazone 1-g tablets (First Priority, Elgin, Illinois, USA), 2.2 mg/kg BW, PO, q12h for 5 d.

After sedation with acepromazine (MWI/VetOne), 0.02 mg/kg BW, IV and xylazine (MWI/VetOne), 0.5 mg/kg BW, IV, general anesthesia was induced with tiletamine/zolazepam (Telazol; Zoetis, Exton, Pennsylvania, USA), 2.0 mg/kg BW, IV and propofol (Zoetis), 0.4 mg/kg BW, IV, and maintained with balanced inhalation anesthesia using isoflurane (Isoflo; Zoetis) in oxygen in a semiclosed circle system. The mare was positioned in right lateral recumbency and the surgical sites were clipped, aseptically prepared, and surgically draped.

The left medial patellar ligament desmotomy was performed first, as previously described (2). Following the left medial patellar ligament desmotomy, the left femoral head ostectomy was performed by use of a craniolateral approach to the coxo-femoral joint. A 30-cm curvilinear skin incision was made over the craniolateral aspect of the left coxofemoral joint, extending over the cranial aspect of the greater trochanter and continuing parallel to the long axis of the femur. The superficial gluteal muscle over the greater trochanter was incised and retracted caudodorsally. The tensor fascia latae and vastus lateralis muscle were separated via blunt and sharp dissection and retracted caudally. The caudal part of the greater trochanter was palpated and used as a guide for the approach to the femoral head in its craniodorsally displaced location. The middle and deep gluteal muscles were partially transected and retracted cranially and caudally to obtain access to the femoral head. The ilium was palpated axial to the head of the femur. Hohmann bone elevators were used to rotate and elevate the femoral head from the surrounding tissue. Femoral head ostectomy was performed using an oscillating bone saw to establish a cutting plane along the neck of the femoral head, and an osteotome was used to complete the femoral head transection. The transected surface of the femur was smoothed with a bone rasp and the surgical site was copiously lavaged with sterile saline (0.9% NaCl) solution. No. 0 polygalactin 910 (Vicryl; Ethicon, Somerville, New Jersey, USA) was used to close the muscle layers in an interrupted cruciate pattern. The subcutaneous tissue was closed using No. 0 polygalactin 910 in a simple continuous pattern. The skin was closed using No. 2-0 polypropylene suture (Prolene; Ethicon, San Lorenzo, Puerto Rico) in an interrupted cruciate pattern. A stent bandage was applied over the closed incision. Total surgical time was 135 min. The horse’s recovery from anesthesia was hand-assisted and without complications. Immediately following recovery, the horse received a dose of butorphanol (Turbogesic; Zoetis), 0.04 mg/kg BW, IM, once. The mare bore full weight on the left hind limb and ambulated with minimal discomfort.

The mare was hospitalized for 4 d following surgery, during which time she seemed comfortable and was able to bear full weight on the left hind limb. The stent bandage was removed 3 d after surgery, and the incision appeared to be healing appropriately. The mare walked with a moderate lameness (AAEP grade 4/5) (1) that gradually improved during hospitalization. Transrectal ultrasonography was performed prior to the mare’s discharge from the hospital; a moving fetus was visualized and a fetal heartbeat was detected. Due to the owners’ financial limitations, post-operative radiographs were not taken. At the time of discharge the mare weighed 116 kg.

Clinicians recommended to the owners that they house the mare in a small paddock for a minimum of 2 mo, allowing the mare to ambulate in a quiet environment. The mare was rechecked by the referring veterinarian and the skin sutures were removed 14 d after surgery. Passive range of motion exercises of the left hind limb were performed by the owners for 10 min several times each day.

The mare returned to the VMCVM VTH 10 wk after surgery for examination of the fetus and assessment of surgical site healing. The mare was housed in a pasture at this time and the owners were continuing left hind limb passive range of motion exercises. The owners reported that the patient was fully weight bearing on the affected limb and seemed comfortable, but they had not observed the horse to lie down. The mare had a moderate hip hike when ambulating (AAEP lameness grade 4/5) (1) and a shorter stride of the left hind limb compared with the right hind stride. The left hind limb seemed to be mildly shorter than the right hind limb and there was moderate muscle atrophy.
of the left gluteal muscles. The surgical sites had healed appropriately without complications. Transabdominal ultrasonography was performed and a viable fetus with a heartbeat was detected.

Approximately 6 mo after surgery, the mare was re-evaluated at the VMCVVM hospital. At that time, the mare weighed 121 kg and was housed in a stall at night and on pasture during the day. The horse was reported to ambulate with ease, but still had not been observed to lie down. The owners continued to perform passive range of motion exercises of the affected limb. The left hind limb remained slightly shorter than the right hind limb. Lameness examination at the walk revealed a mild hip huck of the left hind limb and shorter stride compared with the right hind limb, which was improved from the previous assessment. A hoof pad was conformed to the shape of the horse’s left hind hoof and applied to the sole with elastic tape to elevate the limb to the same height as the right hind. Following application of the hoof pad, the mare immediately walked with a longer left hind stride, matching the stride length of the right hind limb. The owners were advised to continue with the passive range of motion exercises and keep the left hind hoof pad in place.

Follow-up telephone communication with the owners was regularly obtained weekly and multiple visits of one author (EKL) were performed to the horse’s farm. The mare’s comfort improved dramatically following the application of the left hind hoof pad. The horse was noted to trot in the pasture, and get up and down from recumbency with ease. Nine months after surgery, the mare successfully foaled, after which the left hind hoof pad was no longer applied and passive range of motion exercises were discontinued. Immediately post-parturition, the mare became substantially more active in the pasture, trotting and cantering with minimal lameness (Figure 2). The mare was successfully re-bred via live cover and foaled with no complications. Lameness examination performed by one author (EKL) 17 mo after surgery revealed the mare’s hind limbs to be similar lengths, with the left hind limb very mildly shorter than the right hind limb, and there was no atrophy of muscles of the left hind limb. There was minimal lameness (AAEP grade 1/5) (1) observed at the walk, trot, and canter, and the left hind limb flexed and extended normally. At the time of most recent follow-up, 23 mo following surgery, the owners were extremely satisfied with the mare’s comfort level and minimal lameness.

**Discussion**

We treated a coxofemoral joint luxation in a large, pregnant miniature horse with a femoral head ostectomy. The mare recovered from the procedure with relative ease, successfully foaled, and has remained comfortable with minimal lameness after surgery. Coxofemoral joint luxation is an uncommon injury in horses (3–7). The heavy musculature, round ligament, and accessory ligament of the femoral head, and transverse acetabular ligament that surrounds the acetabulum provide strength and stability to the hip (3,5,7–9). Equine coxofemoral joint luxations, therefore, are frequently caused by a traumatic event, such as a kick or fall (3–8,10–12). Coxofemoral joint luxation is typically unilateral with the femoral head oriented craniodorsal to the acetabulum; foals, ponies, and miniature horses are most commonly reported (4,5,7,8,12). In full sized horses, however, the ilium is more likely to fracture than the coxofemoral joint luxating as a result of trauma (6). Additionally, coxofemoral luxations can occur during recovery from anesthesia, due to a hind limb cast or previous injury, or secondary to upward fixation of the patella (5–7,13–15). Some authors have speculated that upward fixation of the patella can cause a strong contraction of the quadriceps femoris muscle as the horse attempts to flex the locked stifle, resulting in coxofemoral joint luxation (3,6,9,16). Alternatively, a luxated coxofemoral joint may cause external rotation of the hind limb: the rectus femoris muscle is unable to release the patella and the mechanics of the femoropatellar joint are altered, resulting in upward fixation of the patella (5,7,9,11). The inciting cause of coxofemoral joint luxation in this horse was unknown, as the mare was found lame in the paddock. After the horse was diagnosed with the luxation and the upward fixation of the patella, the owners reported the mare might have had previous episodes of a locked left stifle. Therefore, it is possible that upward fixation of the patella may have resulted in the coxofemoral joint luxation in this mare. Alternatively, the mare could have suffered an unseen trauma which resulted in the coxofemoral joint luxation.

Horses affected with coxofemoral joint luxation have severe lameness, with the affected limb rotated externally (the toe and stifle point away from the horse) (3,6–11). The pelvis may appear asymmetric and the affected limb may be shorter than the contralateral limb (8,10,16). The shortened limb length can result in a decreased cranial stride length of the affected limb when ambulating (3,7). Manipulation of the affected hind limb may result in detection of crepitus or signs of pain (3,7,10,16). The mare in this report had external rotation of the left hind limb and asymmetry of the pelvis, but no crepitus when the limb was manipulated. Diagnosis of coxofemoral joint luxation can be made on the basis of patient history, clinical signs, and diagnostic imaging. Radiography can be performed for a standing or anesthetized patient to confirm the diagnosis and rule out other potential injuries (3,9). Ventrodorsal radiographic views of the pelvis are typically obtained for patients during general anesthesia; however, ventrodorsal radiographic views have been obtained in standing animals (9,11,15,17,18). The use of general anesthesia to facilitate radiographic imaging is an added expense, and carries risks associated with anesthetic use and patient recovery (9,19). Laterolateral and lateral-oblique radiographic views performed for standing horses are adequate for diagnostic imaging of coxofemoral joint luxation and were performed on the horse in this report (6,9,16,20,21). Ultrasonography can also be used to diagnose coxofemoral joint luxation and subluxation for standing horses (3,10,18,19).

Treatment options for coxofemoral joint luxations include closed reduction, open reduction, greater trochanter transposition, augmentation of the lateral joint capsule, toggle pinning, total hip arthroplasty, or femoral head ostectomy (3,4,6–8,10,11,15,16,20,22,23). Closed reduction is often not successful or re-luxation can occur quickly (3,8). Failure of closed coxofemoral joint luxation reduction is often attributable to blood clots, granulation tissue, joint capsule, tissue, or ligamentous debris in the acetabulum and the contraction of surrounding musculature (3–5,8,11,21,22). Results of 1 study
reported 4 of 5 horses with coxofemoral luxation treated via closed reduction re-luxated (7) and for patients in which closed reduction was successful, osteoarthritis, and persistent lameness developed (6). Greater trochanter osteotomy provides good exposure of the coxofemoral joint and increases ease of manipulation (21,24). Also, a greater trochanter transposition procedure provides further support to the reduced luxation (4). Joint capsule augmentation and toggle pinning have been used successfully in combination or alone in several cases (4,10,11). Total hip arthroplasty has been attempted for 3 patients, but these animals did not survive to hospital discharge (22,23).

Femoral head osteotomy is generally considered to be a salvage procedure for horses with coxofemoral joint luxation (4,8,22,24). During this procedure, the head of the femur is excised; after surgery, a pseudoarthrosis forms that provides pain relief to the horse (15,16,20). Rasp ing the transected end of the femur smooths the bone, helping to prevent osteochondral fragmentation and postoperative lameness (16,24). Authors of previous studies have concluded that patient prognosis following femoral head osteotomy is mainly dependent on patient weight, with a favorable prognosis for patients weighing less than 100 kg (21,24,25). In a report on femoral head osteotomies in 9 horses, 6 horses weighed 100 kg or greater (range: 100 to 225 kg) at the time of surgery, and 4 of these 6 horses were euthanized after surgery (24). Overall, the prognosis following treatment of coxofemoral joint luxations is guarded, with 50% or fewer of horses surviving (7,8,10,17,24). If reduction of the femoral head in the acetabulum is maintained, most horses are sound enough for breeding, with a small number of horses returning to complete soundness (3).

The 6-day duration of the coxofemoral joint luxation and failures at closed reduction resulted in the decision to perform femoral head osteotomy for the mare of this report. Our treatment goal was to improve the mare’s comfort to a level that would allow breeding and a high quality of life during pasture activity. This horse was pregnant; to our knowledge, this surgical technique has not been reported for a pregnant mare. Other mares have been reported to successfully foal following femoral head osteotomy, but the surgical procedure was performed for these mares when they were foals (1-week-old, 1-month-old, and 4-months-old), allowing for prolonged postoperative healing prior to maturation, pregnancy, and parturition (17,24). Additionally, this horse weighed 113 kg at the time of surgery, which was heavier than most horses for which femoral head osteotomy procedures had been previously reported, and the mare was gaining weight due to pregnancy (15–17,20,21,24). We were uncertain as to whether the mare in this study would be able to carry a fetus to term, support the additional weight of the foal, and foal successfully following the femoral head osteotomy. The mare was able to foal with no complications, was rebred via live-cover, showing no signs of discomfort from the weight of the stallion during breeding, and was able to foal a second time successfully.

While there are other published reports on successful femoral head osteotomies in equines, few have the detailed follow-up of this report (15–17,20,21,24). The comfort level and lameness for the patient of this report were improved immediately following surgery and continued to improve during the following 23 mo. Previously published reports described a range of post-operative lameness, with the AAEP lameness scale used in only 2 cases, and these cases involved AAEP grades 2/5 and 3/5 (15–17,20,21,24). The mare in this report was AAEP grade 1/5 at the last examination. Left hind limb passive range of motion exercises and the addition of a hoof pad to the left hind hoof may have contributed to the horse’s minimal lameness. The gradual postoperative recovery resulted in the horse having similar hind limb lengths and no obvious atrophy of the left gluteal muscles.

Femoral head osteotomy for the treatment of a chronic coxofemoral joint luxation was successful in this large, pregnant miniature horse, with no negative effects on postoperative parturition and re-breeding. Additionally, the mare was able to return to near-baseline soundness (AAEP grade 1/5 lame), an improvement over previous reports of femoral head osteotomy in horses (1,16,17,21,24). Femoral head osteotomy can result in an excellent outcome for treatment of coxofemoral joint luxations in large miniature horses and ponies.

References


1. A) Exogenous steroids can cause the clinical signs of hyperadrenocorticism and suppress adrenal function. Clinical signs suggest hyperadrenocorticism, yet there is a poor cortisol response to the administration of ACTH. In naturally occurring hyperadrenocorticism, the ACTH response test is typically exaggerated. These results suggest iatrogenic hyperadrenocorticism.

2. C) FIV is most prevalent in cats 6 years of age or older. Ocular disorders are associated with FIV. Cats exhibit clinical signs within 4 to 6 weeks after exposure. Most infections occur via bite wounds.

3. B) Virus is shed about 10 days before the onset of clinical signs. B) Le virus est libéré environ 10 jours avant l’apparition des signes cliniques.

4. A) Adrenal insufficiency is seen in horses just off the track, just back from extensive training, or in those with a history of exogenous glucocorticoid administration.

5. B) Subclinical coliform infections usually clear within a few hours, so culture based on somatic cell counts are unrewarding. Problem-solving should point-source fecal contamination of teat and udder skin, and lack of removal prior to milking. Although contamination can occur at any time in the daily cycle, infections are introduced around the time of milking, when the teat sphincter muscle is relaxed. For this reason, cows should stand (e.g., eating at the feed bunk) for 30 minutes after milking. 

Escherichia coli bacterins reduce the prevalence and severity of coliform mastitis.
Case Report  

Rapport de cas

Frontal and caudal maxillary sinus lipoma in a horse

Elsa K. Ludwig, Christopher R. Byron, Kevin K. Lahmers, Marcos P. Santos

Abstract — An adult horse was diagnosed with a frontal and caudal maxillary sinus lipoma, which was surgically removed. This is the first known report of a sinus lipoma in a horse. Lipomas should be considered in the differential diagnoses of equine sinus masses; complete surgical excision appears to be curative.

Résumé — Lipome du sinus maxillaire frontal et caudal chez un cheval. Un cheval adulte a été diagnostiqué avec un lipome du sinus maxillaire frontal et caudal qui a été enlevé par chirurgie. Il s’agit du premier rapport d’un lipome de sinus chez un cheval. Les lipomes devraient être considérés dans les diagnostics différentiels des masses des sinus chez les équidés; l’excision chirurgicale complète semble être curative.

Can Vet J 2017;58:503–507

Case description

A 17-year-old American Warmblood mare was referred to the large animal hospital at the Virginia-Maryland College of Veterinary Medicine (VMCVM) for evaluation because of a 5-month history of right-sided mucopurulent nasal discharge. Prior to referral, the mare had been treated with a 7-day course of oral sulfamethoxazole-trimethoprim, which did not resolve or ameliorate the nasal discharge. At the time of admission, the mare was bright and alert and weighed 564 kg with a body condition score of 7/9. Pulse, respiratory rate, and rectal temperature were all within normal limits (40 beats/min; 12 breaths/min; 37.9°C). No abnormal findings were detected during pulmonary and cardiac auscultation, and capillary refill time was < 2 s. A moderate amount of pale yellow, purulent discharge was evident in the right naris. Xylazine (MWI/VetOne, Boise, Idaho, USA), 0.3 mg/kg body weight (BW), IV, was administered to facilitate dental examination by use of an oral speculum, dental mirror, and dental pick. A diastema was detected between teeth 108 and 109, and when probed with a dental pick, tooth 109 was suspected to have infundibular caries. During upper respiratory tract endoscopy, moderate pharyngeal hyperemia and swelling over the pharyngeal recess were detected in addition to a mild pharyngeal lymphoid hyperplasia. A moderate amount of serous discharge was present within the trachea and there was a significant amount of purulent material emanating from the right nasomaxillary aperture. Both guttural pouches were free of abnormalities.

Skull radiography revealed increased soft tissue opacity within the right maxillary sinus (Figure 1) and a soft tissue
projection of the axial border of the maxillary sinus into the right oral cavity resulting in mild deviation of the nasal septum (Figure 2). Additionally, there was mild lysis of periapical bone and blunting of the mesial root tips of teeth 107 to 109. Based on the results of the dental examination, upper respiratory endoscopy, and radiographs; apical root infection of tooth 109 with suspected secondary right maxillary sinusitis was diagnosed. Extraction of tooth 109 per os and right rostral maxillary sinus trephination were elected for treatment of the suspected apical tooth root infection and maxillary sinusitis. Prior to tooth extraction and sinus trephination, the mare received phenylbutazone (MWI/VetOne), 4.4 mg/kg BW, IV, and sulfamethoxazole-trimethoprim (Aurobindo Pharma USA, Cranbury, New Jersey, USA), 30 mg/kg BW, PO. The patient was then sedated with detomidine (Dormosedan; Zoetis, Kalamazoo, Michigan, USA) and butorphanol (Turbogesic; Zoetis, Exton, Pennsylvania, USA) both at 0.01 mg/kg BW, IV, and sedation was maintained with an IV detomidine constant rate infusion (0.04 mg/kg BW per hour). A right maxillary nerve block was given with 15 mL of 2% mepivicaine (Carbocaine-V 20 mg/mL; Zoetis) and the 109 tooth was extracted per os with the horse standing. Following the tooth extraction, the trephination site for the right rostral maxillary sinus was clipped and aseptically prepared. A 1.5-cm diameter, semi-circular skin incision was made on the mid-dorsal aspect of the right rostral maxillary sinus. Muscle and connective tissue below the skin incision were bluntly separated, and a 1-cm diameter Galt trephine was used to create the sinus opening. The rostral maxillary sinus was lavaged with 3 L of sterile saline (0.9% NaCl) solution, and the trephination site was left open to facilitate future sinus lavage. The empty 109 tooth alveolus was then dried and packed with vinyl polysiloxane impression material via an oral approach. Following tooth extraction and sinus trephination, the horse was discharged with instructions advising the owner to continue the oral sulfamethoxazole-trimethoprim, 30 mg/kg BW, q12h for 14 d. Phenylbutazone (1 g tablets; First Priority, Elgin, Illinois, USA), 2.2 mg/kg BW, PO, was to be administered q12h for 3 d, then q24h for 3 d. The sinus was to be lavaged with 1 mL of 10% povidone-iodine solution in 1 L sterile saline (a 1% povidone-iodine solution) q12h for 7 to 10 d, and then q24h for 7 to 10 d. The vinyl polysiloxane impression material was to be removed 4 wk following tooth extraction. Follow-up communication with the owners was obtained monthly via telephone. Following discharge from the VMCSV, the mare’s right-sided nasal discharge resolved and the trephination site healed with no complications. The mare returned to her original level of performance with no complications. Six months after the initial evaluation, the horse was returned to the VMCSV with a 1-week history of right-sided nasal discharge. At presentation, the patient weighed 545 kg, had a heart rate of 36 beats/min, a respiratory rate of 18 breaths/min, and a rectal temperature of 38°C. A moderate amount of tan, mucopurulent discharge was present in the right naris. No other abnormalities were noted during physical examination. The mare was sedated with detomidine (0.01 mg/kg BW, IV) and a dental examination was performed. The alveolus of the 109 tooth was filled with healthy granulation tissue. Upper

Figure 2. Dorsoventral radiograph of the skull showing soft tissue projection of axial border of the right maxillary sinus (arrow) and mild deviation of the nasal septum.

Figure 3. Endoscopic image of a soft tissue mass (arrow) within the right common nasal meatus.
airway endoscopy revealed a rounded, soft tissue mass within the right common nasal meatus, rostral to the nasomaxillary aperture (Figure 3). A moderate amount of mucopurulent material was draining from the nasomaxillary aperture. Skull radiography identified a soft tissue opacity in the right caudal maxillary sinus (Figure 4) and moderate deviation of the nasal septum (Figure 5). The patient's history of right maxillary sinusitis, recurrence of nasal discharge following 109 tooth extraction, and findings on endoscopy and radiography were suggestive of a right caudal maxillary sinus mass.

The mare received procaine penicillin G (Pfizerpen; Pfizer, New York, New York, USA), 22,000 IU/kg BW, IM, gentamicin (Sparhawk Laboratories, Lenexa, Kansas, USA), 6.6 mg/kg BW, IV, and phenylbutazone (4.4 mg/kg BW, IV) prior to standing surgery. Detomidine (0.01 mg/kg BW) was administered IV to sedate the horse for surgical site preparation. The dorsal aspect of the horse's head was clipped and cleaned. A supraorbital nerve block was given using 3 mL of 2% mepivacaine (20 mg/mL) and a line block along the proposed skin incision was done using 2% mepivacaine (20 mg/mL). The surgical site was aseptically prepared and the mare was started on an intravenous continuous rate infusion of detomidine (0.01 mg/kg BW per hour). A right-sided frontonasal bone flap was created by use of routine methods using an osteotome. Once the frontonasal bone flap was elevated, a 9 × 11 cm smooth mass of lipid consistency was seen in the frontal sinus and extended into the caudal maxillary sinus (Figure 6). The mass was digitally separated from the surrounding sinus walls, removed, and submitted for histopathologic examination. The caudal maxillary and frontal sinus lining was removed and the sinus was copiously lavaged with sterile 0.9% NaCl solution. A Foley catheter was passed through the right naris and into the right frontal sinus to facilitate future lavage of the sinus. The sinus flap was then replaced and the periosteum was closed in a simple continuous pattern using No. 2-0 polyglactin 910 (Vicryl; Ethicon, Somerville, New Jersey, USA) suture material. The subcutaneous tissue was closed in a simple continuous pattern using No. 2-0 polyglactin 910 suture material, and the skin was closed with No. 2-0 polypropylene (Prolene; Ethicon, San Lorenzo, Puerto Rico) suture material in a simple interrupted pattern.

The patient recovered uneventfully from sedation. Following surgery the mare received oral sulfamethoxazole-trimethoprim (30 mg/kg BW, PO), q12h for 14 d and phenylbutazone (2.2 mg/kg, PO) was to be administered orally q12h for 3 d, then q24h for 3 d. The surgical site was lavaged q12h with 1 mL of 10% povidone-iodine solution in 1 L sterile saline for 3 d using the Foley catheter. The catheter was removed before the horse was discharged from the hospital. The mare was to be stall rested for 14 d, then transitioned to a small paddock for 14 d before returning to work. Skin sutures were to be removed 14 d following the standing surgical procedure and the mare was to return to the VMCM after 30 d for reassessment and diagnostic imaging.

Results of histopathologic examination of the sinus mass were unusual. The large, tan, soft mass (Figure 7) was entirely composed of large cells in sheets subdivided by mature fibrous tissue and small amounts of hemorrhage. The cells were polygonal with large, clear, discrete cytoplasmic vacuoles that displace and compress nuclei (Figure 8). The space occupying mass was
interpreted as a lipoma based on the normal appearing adipocytes. Biweekly telephone communication with the owner was established. The mare’s skin incision healed appropriately, and there was no nasal discharge following the surgical procedure. The mare returned to the VMCVM 16 wk after the surgical procedure for reassessment. The horse was not reported to have nasal discharge by the owner, and a mild boney callus was present at the distal margin of the right-sided frontonasal bone flap. The patient’s vital parameters were within normal limits. The horse was sedated with xylazine (0.3 mg/kg BW, IV) for skull radiography. Examination of the radiographs indicated there was no recurrence of the soft tissue mass, and smooth periosteal proliferation was present on the level of the rostral frontal and caudal maxillary bone. Repeat endoscopy was declined by the owner due to financial limitations. The mare was discharged from the hospital with the recommendation to return in 6 mo for repeat assessment to ensure the sinus lipoma was not recurring. Follow-up communication with the owner 16 mo after the mare’s initial assessment indicated that the mare had returned to full work and had had no known episodes of nasal discharge since the surgical procedure.

Discussion

Diseases affecting the equine sinuses can result in the production of nasal discharge and decreased nasal airflow, which can progress to cause facial swelling or deformity (1–5). Sinus disease can be due to primary infections or secondary to dental disease, progressive ethmoid hematomas, sinus cysts, or neoplasia (1–5). Equine sinonasal neoplasia is rare, comprising 8% to 19% of sinonasal disorders (2,5). Reported equine sinonasal neoplasms include squamous cell carcinoma, fibroma, adenocarcinoma, fibrosarcoma, myxoma, osteoma, carcinoma, mast cell tumor, hemangioma, hemangiosarcoma, adenoma, lymphosarcoma, melanoma, and sarcoma (2,6–9).

Most reports indicate that lipomas constitute about 3% of all equine neoplasms (10–12), but one survey found that 13% of 151 equine tumors were mesenteric lipomas (13). In horses, lipomas are most frequently located in the abdomen, and may be the most common equine intra-abdominal neoplasm (10,11,14). Rarely, lipomas may develop at other anatomic locations; such masses have been detected in paraurethral, meningeal, subcutaneous, intramuscular, intrathecal, pericardiac, and nuchal ligament locations (14–21). To the authors’ knowledge, this is the first report of a paranasal sinus lipoma in a horse. There are limited reports of nasal, paranasal sinus, and nasopharyngeal lipomas in humans (22–30). Since 1915, only 5 human cases of paranasal sinus lipomas have been reported (22–24,26,29). Lipomas are rarely detected in the nasal cavity, paranasal sinuses, and nasopharynx due to the lack of adipose tissue in these regions (26).

Lipomas are most often benign, slow-growing tumors with uncertain etiology that arise from lipocytes (10,29,31). Trauma or chronic tissue irritation has been proposed as causes of oral lipomas in humans (31). In horses, lipomas grossly appear as soft and fatty masses, and may or may not be encapsulated (10). Histopathologically, lipomas are composed of mature adipocytes supported by vascular connective tissue (10,27,28). The sinus mass removed from the mare in this report matched both the gross and histopathologic description of a lipoma. Surgical excision of lipomas is the treatment of choice, and lipomas usually do not recur following complete excision (10,27,30,31). Surgical

Figure 6. Photograph of the elevated right frontonasal sinus flap. Note the soft tissue mass (arrow).

Figure 7. Photograph of the large, tan, soft mass removed from the right frontal and caudal maxillary sinus.
excision of the sinus lipoma in the mare of this report resulted in a successful outcome.

Interestingly, 2 of the reported paranasal sinus lipomas in humans occurred following Caldwell-Luc procedures (26,29). The Caldwell-Luc procedure is a surgical procedure that creates an opening into the maxillary sinus via the sublabial area over the canine fossa (32). This opening provides excellent sinus visualization and the procedure is used for cases of chronic maxillary sinusitis or the removal of sinus masses (32,33). It has been suggested that the Caldwell-Luc procedure may stimulate the development of a lipoma, or that the tumor may develop as a result of perioperative diversion of lipocytes (29). Maxillary sinuses in horses can be surgically approached via rostral maxillary sinus trephination, a procedure similar to the Caldwell-Luc procedure (34). The mare of this report had rostral maxillary sinus trephination performed at the time of initial presentation.

Lipomas have been reported following tooth extractions in humans (22,35). A 1942 case report described the discovery of a lipoma in a patient’s maxillary sinus following the failure of an empty tooth alveolus to heal after removal of the tooth (22) and a 2004 paper that reviewed the clinicopathologic features of 125 lipomas of the oral and maxillofacial region reported that 1 patient associated the tumor with a previous tooth extraction (35). Regarding the mare of this report, the surgical procedure performed at the time of the patient’s initial hospitalization may have resulted in lipoma formation. Alternately, it is possible that the sinus lipoma was present at the time of the initial treatment.

Lipomas of the paranasal sinus are rare in horses, and have not been reported in horses. This is the first report of a sinus lipoma in a horse. Lipomas should be considered in the differential diagnoses of equine sinus masses; complete surgical excision seems to be curative.

References

Idiopathic glaucoma in an 11-year-old crossbred mare

Daniella Rizzo

Abstract — An 11-year-old crossbred mare was presented with left eye buphthalmia, a mydriatic minimally responsive pupil, locally extensive ventral corneal edema, and corneal striae. Intraocular pressures exceeding 80 mmHg lead to a presumptive diagnosis of glaucoma. Following several days of treatment there was no improvement and enucleation was performed.

Résumé — Glaucome idiopathique chez une jument de race croisée âgée de 11 ans. Une jument de race croisée âgée de 11 ans a été présentée avec une buphtalmie de l’œil gauche, une pupille mydriatique minimalement réactive, un œdème cornéen ventral important localement et une strie cornéenne. Les pressions intraoculaires dépassant 80 mmHg ont donné lieu à diagnostic présomptif de glaucome. Après plusieurs jours de traitement, il n’y avait aucune amélioration et l’énucléation a été réalisée.

Can Vet J 2017;58:508–510

A previously healthy 11-year-old gray Arabian-Quarter Horse crossbred mare was presented to the veterinarians of Springer Animal Hospital with complaint of a “swollen left eye” of 1 day duration. On neuro-ophthalmic examination of the left eye there was a diminished direct dazzle and pupillary light reflex. The indirect pupillary light reflex was normal. Palpebral reflexes of the left eye were normal, the eye was fluorescein stain negative with a positive Jones test, and the mare appeared to be visual with a positive menace response. Ocular lesions noted in the left eye were buphthalmia, brown pigmentation of the sclera, mild episcleral injection, a 5-mm diameter semi-circular area of edema located ventrally within the cornea, linear corneal band opacities extending from limbus to limbus, and the pupil appeared dilated with a diminished response to light (Figure 1).

No other ocular abnormalities were noted in the left eye but it was difficult to perform a thorough fundic examination due to the presence of obscuring edema; what we were able to evaluate appeared normal. No anomalies were noted in the right eye.

Initially, the patient was treated with a 1-cm strip of sodium chloride, 5% (Muro 128; Bausch & Lomb, Vaughan, Ontario) applied topically q6h, and 500 mg of flunixin meglumine (Banamine; Merck AH, Toronto, Ontario) given IV initially, then PO, q12h. Two days after initial presentation, intraocular pressures were measured with a tonometer (Tono-Pen; Reichert Technologies, New York, New York, USA) while the horse was lightly sedated with 0.7 mg of xylazine (Xylamax; Bimeda, Cambridge, Ontario) given IV, and 2 drops of topical proparacaine hydrochloride, 0.5% (Alcaine; Alcon Canada, Mississauga, Ontario) were applied, with intraocular pressures averaging 88 mmHg (left eye) and 22 mmHg (right eye). On neuro-ophthalmic examination, the edematous area in the cornea was now almost completely encircling the pupil, measuring approximately 7 mm in diameter, the linear corneal band opacities were more prominent, and the pupil had become fixed and minimally responsive to light stimulus. The horse had minimal tearing and did not appear to be in pain. Working with a presumptive diagnosis of glaucoma, 1 to 2 drops of 20 mg/mL dorzolamide hydrochloride and 5 mg/mL timolol maleate (Cosopt; Merck AH) applied topically to the left eye q8h was added to the treatment protocol to control intraocular pressure (IOP).

Three days later, on re-check examination, the corneal edema had dissipated by approximately 1/3, leaving a 5-mm circular area in the ventrum of the cornea. Intraocular pressures were averaging 86 mmHg (left eye) and 22 mmHg (right eye). All further treatment options were discussed with the owner including long-term medical management, referral, surgical treatment, and enucleation as a salvage procedure. One week later, the owner elected to enucleate. On pre-operative examination of the eye, it was noted that there were several centrally located pinpoint areas of fluorescein stain uptake, implying micro- ulceration of the cornea. The eye was enucleated using a standing subconjunctival surgical approach. The eye was fixed in formalin solution and sent to the Animal Health Laboratory, University of Guelph for histopathological evaluation.
Glaucoma is a disease affecting aqueous humor outflow pathways in the eye that result in phasic elevations of intraocular pressure to levels incompatible with eye health (1,2). This condition is not commonly diagnosed in horses and its mechanisms are poorly understood. Glaucoma occurs in stages; initially there is an event that leads to the hindrance of aqueous outflow systems, followed by the system becoming fully obstructed through morphological changes and intraocular pressures begin to increase (1). High intraocular pressures are what lead to the clinical signs associated with glaucoma, including scleral blood vessel congestion, corneal edema, and fixed pupils. The intraocular pressure eventually exceeds a level at which the optic nerve and retinal ganglion cells can function, leading to optic nerve axon degeneration, progressive loss of vision, and eventually, blindness (1).

In a normal eye, aqueous outflow exits the globe through the iridocorneal angle (ICA) and the uveoscleral pathway (3). Obstruction of the pathways can result from the development of pre-iridal fibrovascular membranes, blockage of the ICA with inflammatory debris, pupillary block resulting from posterior synechia and development of iris bombe, trabecular compression, and angle closure (1). It has also been proposed that uveal atrophy after an inflammatory event may predispose the ICA to collapse, along with blockage of the ICA by a tumor or other pathologic processes (1).

While all glaucomas occur secondary to a causative mechanism, equine glaucoma is frequently categorized into 3 types: congenital, primary, and secondary. Congenital glaucoma is associated with developmental abnormalities of the anterior segment (4). Primary glaucoma is seen with acquired, but often inherited ICA degeneration (2). Secondary glaucoma is the type most commonly diagnosed in horses with primary uveitis, with some hypothesized links to equine recurrent uveitis (ERU), along with neoplasia, lens luxation, and trauma (4).

Diagnosis of glaucoma in equine patients is challenging, as horses tend to exhibit the initial clinical signs of glaucoma more subtly than other species. Diagnosis can be confirmed if elevated intraocular pressure (anything exceeding normal pressures which range from 17 to 28 mmHg) can be documented in the presence of clinical signs of glaucoma, as described for the present case (2). This may prove difficult if the horse is concurrently afflicted with equine recurrent uveitis, as intraocular pressure may not be consistently elevated and a diseased globe can experience large diurnal fluctuations (1). For accurate diagnosis, an auriculopalpebral nerve block can be performed to reduce the chances of a false positive secondary to manipulation of the eye and eyelids. Variation among different devices and normal diurnal pressure fluctuations should be taken into account when taking IOPs for diagnostic purposes. Comparing IOPs with the normal or unaffected eye can also help confirm the diagnosis as there should not be large IOP differences between the right and left eyes, as occurred in this case.

During the acute or active phase of glaucoma, a mydriatic pupil may be seen along with mild to moderate corneal edema, mild to severe blepharospasm, aqueous flare, corneal striae, uveitis, and lens luxation (1). When glaucoma becomes chronic, corneal edema may be severe or permanent, corneal striae are often seen along with extensive posterior synechia, optic nerve atrophy with the lamina cribrosa exposed, hydrophthalmos, inconsistent aqueous flare, lens luxation (typically posterior), and blindness. Horses may display a range of none to all of these clinical signs, and tend to remain somewhat visual even in the late stages of disease, making detection and diagnosis of glaucoma even more challenging. In the current case, we suspected the horse to be in the acute/active stage of glaucoma, which was further supported by the histological analysis of the eye.

A histopathological retrospective study done by Curto et al (3), found that the most common histological lesions found in glaucomatous eyes included corneal stromal vascularization, multiple breaks in Descemet’s membrane, loss of nerve fibers and ganglion cells from the inner retina, optic disc cupping, gliosis, and axonal loss from the optic nerve. This study also determined that there appeared to be no sex predilection for development of glaucoma, that horses over the age of 15 are at the highest risk for development of secondary glaucoma, and Appaloosas (a breed susceptible to ERU) are highly susceptible to developing glaucoma (3).

Treatment for glaucoma involves both medical and surgical management. Several factors including the vision status of the eye, the presence of concurrent disease, the horse’s activity, economic factors, and ease with which the owner can apply treatments will determine which treatment protocols are recommended and optimally used (2). Treatment should focus on reducing intraocular pressure to levels compatible with optic
nerve and retinal health (levels $\leq 20$ mmHg are suggested as acceptable in a glaucomatous eye), decreasing aqueous humor production, and increasing outflow via conventional and unconventional pathways (1). To reduce aqueous humor production, topical $\beta$-adrenergic blockers such as timolol maleate and topical carbonic anhydrase inhibitors such as dorzolamide hydrochloride have proven effective in lowering IOPs (5). Some sources recommend topical atropine treatment to prevent glaucoma in cases of uveitis; however, this is only recommended for use when tonometry is consistently available and uveitis is the underlying cause of the glaucoma (1). Anti-inflammatory therapy with topical corticosteroids such as prednisolone acetate and systemic administration of non-steroidal anti-inflammatory drugs (NSAIDs) such as phenylbutazone or flunixin meglumine can control uveitis and provide pain control (1). With long-term NSAID use, it is recommended that the horse be carefully observed for signs of common complications such as kidney disease or right dorsal colitis.

When medical management is no longer controlling glaucoma, one of several surgical interventions should be considered. Laser transscleral cyclophotocoagulation or ablation is the current surgical treatment of choice; it uses laser energy to preferentially destroy ciliary body epithelium and the stroma of the pars plicata, thereby reducing the amount of aqueous humor produced (2). Transscleral cycloysisurgery is another option involving cryodestruction of the ciliary body using nitrous oxide (1). This method is associated with more severe ocular side effects, and has been limited to use in blind eyes (1). Chemical ablation of the ciliary body with gentamicin may also be used in blind eyes to reduce pain and hydrophthalmos (1). A recent report by Lassaline (6) introduced a new surgical technique that involved placing a Baerveldt glaucoma shunt in an equine eye that had become refractory to treatment, resulting in the reduction of intraocular pressures and retention of vision (7). Finally, salvage procedures involving enucleation or evisceration should be considered if the eye cannot be managed with either technique or if the eye is severely painful or buphthalmic. Silicone implants can be placed for a more esthetically pleasing look, but as in all surgeries complications need to be discussed. In the present case, a combination of economic factors, feasibility of long-term treatment, and failure to respond to treatment lead to the decision to enucleate the affected eye.

With respect to aqueous outflow, the uveoscleral pathway in the horse may be just as important as the ICA pathway is in other species such as the dog (3). There are several features of the anatomy of the iridocorneal angle in the horse that account for these differences (1,3). This is thought to account for the perceived resistance of equine eyes to glaucoma and lower prevalence seen in the population (7). However, it is also possible that lack of diagnostic equipment could also contribute to infrequent diagnosis in the early stages (7). In this case, it was difficult to assess which causative mechanism lead to the secondary development of glaucoma. We hypothesized that it may have been a rare form of primary glaucoma that presents in aged horses, due to the sudden onset of clinical signs with no previous history of ocular pathology and lack of histological evidence of causation. Throughout the investigation and management of this case it became apparent that there is a general lack of literature exploring the pathophysiology of equine glaucoma. Increased understanding of how horses maintain vision in the face of chronically elevated intraocular pressures and the connection between glaucoma and ERU will be paramount in controlling the disease in the future. This is an area that needs to be explored further for us to understand and treat this debilitating disease.

Acknowledgments

The author thanks Drs. Emily Vellekoop, Marcie Ninness, and the team at Springer Animal Hospital, and Drs. Maria Spinato, Brian Wilcock, and Chantale Pinard from the University of Guelph for their help and guidance.

References

Overall, 2016 was a strong year for Canadian veterinarians. Companion animal hospitals experienced small increases in revenue, net income, and both current and new clients. On the mixed and large animal side, a stagnation of revenue was overcome by prudent expense control, allowing for a jump in net income.

Companion animal hospitals enjoyed a healthy 3.5% increase in gross revenue per full-time equivalent (FTE) DVM in 2016 (Figure 1). The gross revenue figure of $538,281 sets a new national high water mark. Over the same time frame, net income ticked upwards by 1.7%, to $162,589. This does not quite reach the record high attained in 2014, but does reverse the downturn seen last year.

These Canada-wide figures, however, can obscure regional differences. Despite the national averages climbing upwards, some provinces experienced downturns. Alberta, Manitoba, and Newfoundland and Labrador veterinary hospitals all suffered declines in both gross revenue and net income. Meanwhile, Ontario, New Brunswick, and Nova Scotia hospitals enjoyed growth above the national averages.

After years of decline, current and new client numbers are finally showing not only resilience, but even noticeable growth. The number of current clients (defined as a client seen within the past 12 months) per FTE DVM climbed by 4.6% in 2016, Dr. Doherty is a graduate of the Ontario Veterinary College and he works as an economic analyst for the Ontario Veterinary Medical Association.

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

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Le Dr Doherty est diplômé de l’Ontario Veterinary College et travaille en tant qu’analyste économique pour l’Ontario Veterinary Medical Association.

Le présent article est rédigé dans le cadre du Programme de gestion commerciale de l’ACMV, qui est cocommandité par IDEXX Laboratories, Petsecure Pet Health Insurance, Merck Santé Animale et la Banque Scotia.

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Après des années de déclin, le nombre de clients actuels et nouveaux montre finalement des signes non seulement de résilience, mais il affiche même une croissance notable. Le nombre de clients actuels (qui sont définis comme des clients qui ont fréquenté la clinique au cours des douze derniers mois) par vétérinaire ETP a augmenté de 4,6 % en 2016 et a dépassé les chiffres atteints en 2014 et en 2015. Le nombre de nouveaux clients par vétérinaire ETP n’a pas connu un rebondissement aussi convaincant, mais il a toujours augmenté de 2,1 %, pour effectuer un retour aux niveaux observés en 2014 (figure 2).

De nouveau, la moyenne nationale masque les différences entre les provinces. Les cliniques vétérinaires de la Saskatchewan et de la Nouvelle-Écosse ont affiché des hausses supérieures à those achieved in both 2014 and 2015. The number of new clients per FTE DVM did not rebound quite as strongly, yet still grew by 2.1%, back to levels seen in 2014 (Figure 2).

Again, the national average masks differences among the provinces. Saskatchewan and Nova Scotia veterinary hospitals had above average increases in the numbers of current and new clients per FTE DVM. British Columbia hospitals, by contrast, witnessed a decline in their client numbers.

Setting 2012 as a baseline, it is obvious that the typical Canadian veterinarian continues to do more with fewer clients. The cumulative change in companion animal current active clients had fallen 5% below 2012 in 2016; yet the annual
la moyenne pour le nombre de clients actuels et nouveaux par vétérinaire ETP. Par contraste, les cliniques de la Colombie-Britannique ont observé un déclin du nombre de clients.

Si l’année 2012 sert d’année de référence, il est évident que le vétérinaire canadien type continue de faire plus avec moins de clients. Le changement cumulatif du nombre de clients actifs actuels pour animaux de compagnie a chuté en deçà des niveaux de 2012 en 2016; pourtant, le revenu annuel par client a atteint une hausse cumulative de 22 % au cours de la même période (figure 3).

Les cliniques vétérinaires mixtes et pour grands animaux ont connu une très légère chute du revenu brut, qui a baissé de 0,7 % en 2016 (figure 4). Cependant, malgré cet obstacle, ces cliniques ont pu réaliser un bond spectaculaire de 13,8 %

Figure 3. Cumulative change in current clients per full-time equivalent DVM and annual revenue per client for companion animal hospitals in Canada from 2012 to 2016./Changement cumulatif du nombre de clients actuels par vétérinaire équivalent temps et du revenu annuel par client pour les cliniques pour animaux de compagnie au Canada de 2012 à 2016.

Figure 4. Gross revenue and net income per full-time equivalent DVM for mixed and large animal hospitals from 2012 and 2016./Revenu brut et bénéfice net par vétérinaire équivalent temps plein pour les cliniques mixtes et pour grands animaux de 2012 à 2016.
In 2016, many hospitals saw bounce backs in a number of their key metrics. Revenue, net income, and client numbers were all holding steady or climbing. In order to ensure success in 2017, hospitals may be best served by implementing strategies to control expense and increase client loyalty.

It is apparent that many mixed and large animal hospitals are already employing the expense control strategy. Setting a budget, sticking to it, and regularly re-assessing goals can allow a practice to convert more gross revenue to flow into net income.

While client numbers are climbing, strong communication remains important to continue this trend. Pre-booking remains a highly recommended strategy; preliminary research and anecdotal evidence show that, when done properly, this can increase client visits and compliance, and decrease the amount of time, money, and effort that hospitals spend trying to re-establish contact with clients to book their next visit.

Finally, wellness plans, which allow clients to pay for their pet’s veterinary care in more manageable monthly installments, are gaining in popularity. In urban areas, with young populations and high costs of living, this type of plan can be a fantastic way for the millennial pet owner to provide their animal with the level of care it requires, without breaking the bank.

With these strategies, and some co-operation from the economy as a whole, veterinarians can ensure that 2017 is even more successful than 2016.

Notes: Data for the CVMA Practice Owners Economic Survey are derived from the 2016 Provincial Practice Owner’s Economic Surveys. Provincial averages are weighted based on relative population size to calculate a national average for all metrics. For the purposes of this research, a full-time equivalent veterinarian is assumed to work 1750 hours annually.

Notes: Les données pour le Sondage économique de l’ACMV auprès des propriétaires de pratique sont dérivées des Sondages économiques provinciaux 2016 auprès des propriétaires de pratique. Les moyennes provinciales sont pondérées en fonction de la taille de la population afin de calculer une moyenne nationale pour tous les paramètres. Pour les besoins de cette recherche, on présume qu’un vétérinaire équivalent temps plein travaille 1750 heures par année.
History and clinical signs

A 13-year-old spayed female domestic shorthaired cat was examined at the ophthalmology service at the Western College of Veterinary Medicine. This cat was presented for evaluation of pink masses in the right eye, and uveitis and secondary glaucoma in the left eye. She was being treated with topical prednisolone acetate 1% (Sandoz Prednisolone; Sandoz Canada, Boucherville, Quebec), q6h in both eyes and dorzolamide hydrochloride 2%/timolol maleate 0.5% combination (Cosopt; Merk Frosst Canada, Kirkland, Quebec), q12h in the left eye. The menace responses, and palpebral, oculocephalic, direct and consensual pupillary light reflexes were present bilaterally. Schirmer tear test (Schirmer Tear Test Strips; Alcon Canada, Mississauga, Ontario) values were 35 and 31 mm/min in the right and left eyes, respectively. The intraocular pressures were estimated with a rebound tonometer (Tovet; Tiolat, Helsinki, Finland) and were 13 and 19 mmHg in the right and left eyes, respectively. Fluorescein staining (Fluorets; Bausch & Lomb Canada, Markham, Ontario) was negative bilaterally. On direct examination there was mild bilateral conjunctival hyperemia; the right eye had 2 pink, nodular masses extending from the iris, and hypopyon was present. Following application of 0.5% tropicamide (Mydriacyl; Alcon Canada) biomicroscopic examination (Osmram 64222; Carl Zeiss Canada, Don Mills, Ontario) revealed moderate aqueous flare in the right eye. Mild aqueous flare, incipient cortical cataract, and a lateral aphakic crescent were present in the left eye. Additionally, white infiltrates were visible adjacent to the ciliary body and posterior to the lens bilaterally. Indirect ophthalmoscopic (Heine Omega 200; Heine Instruments Canada, Kitchener, Ontario) examination was completed and did not reveal further abnormalities in either eye. A photograph of the right and left eyes at presentation is provided for your assessment (Figure 1).

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

Discussion

The clinical diagnoses were iris masses in the right eye, bilateral uveitis, and lens subluxation in the left eye. Historically documented elevated intraocular pressure in the left eye also suggested secondary glaucoma in the left eye. The differential diagnoses for iris masses include primary intraocular tumors such as iridociliary adenocarcinoma, post-traumatic sarcoma, leiomyosarcoma, and poorly pigmented melanocytic tumors; as well as secondary tumors such as lymphosarcoma, histiocytic sarcoma, metastatic carcinoma, hemangiosarcoma, and osteosarcoma (1–5). Bilateral uveitis is most often secondary to endogenous causes and differential diagnoses include systemic infections with agents such as feline leukemia virus (FeLV), feline...
immunodeficiency virus (FIV), feline coronavirus, *Toxoplasma gondii*, fungi, and * Bartonella henselae*. Other etiologies of uveitis include neoplasia, immune-mediated inflammation, and idiopathic (6). Lens subluxation and glaucoma were most likely secondary to chronic uveitis in the left eye. Chronic uveitis is the most common cause of lens subluxation in the feline as it leads to zonular degeneration (7). Glaucoma is also commonly associated with lens luxation. Glaucoma may occur due to a change in aqueous humor dynamics associated with a shift in lens position; however, glaucoma is also a common sequela to feline anterior uveitis and thus, lens luxation and glaucoma may be coincident endpoints of chronic inflammation (8,9).

Ocular neoplasia can be suggested based on appearance and confirmed with cytology of aqueous humor or biopsy of tissue followed by light microscopic examination. Both aqueocentesis and intraocular biopsy are invasive procedures requiring specialized techniques and should only be completed by a veterinary ophthalmologist. When the tumor is extensive and affecting ocular comfort and/or function, enucleation and submission for histopathology is a reasonable means of making a diagnosis. The diagnostic evaluation for bilateral uveitis should include a complete physical examination, complete blood cell count (CBC), serum biochemistry profile, urinalysis, thoracic radiographs, abdominal ultrasound, and select serology. In this cat, a CBC and urinalysis were within normal limits. Serum biochemistry revealed mild panhyperproteinemia with a total protein of 90 g/L (reference range: 53 to 84 g/L) but was otherwise normal. Testing for FeLV/FIV was negative. Thoracic radiographs showed no significant abnormalities. Abdominal ultrasound revealed the liver to be thickened and hyperechoic and the spleen to have mottled parenchyma. Fine-needle aspiration of the liver and spleen was performed and the cytology was not consistent with neoplasia. Aqueous centesis was performed and cytology revealed neoplastic round cells most consistent with a diagnosis of lymphoma. Aqueous humor dynamics associated with a shift in lens position; however, glaucoma is also a common sequela to feline anterior uveitis and thus, lens luxation and glaucoma may be coincident endpoints of chronic inflammation (8,9).

Lymphoma is the most common hematopoietic neoplasm and the most common secondary intraocular tumor in cats (10). Although there are a few case reports of solitary conjunctival and ocular lymphoma, solitary ocular lymphoma is believed to be rare in dogs and cats (11–13). Intraocular lymphoma is generally considered to be part of multicentric disease. The anterior uvea is the most common tissue involved and intraocular lymphoma often mimics anterior uveitis. The uveitis in the left eye of this cat was likely a manifestation of systemic lymphoma rather than idiopathic or immune-mediated inflammation. Nodular iris lesions, as seen in this case, are the most common ocular manifestations of intraocular lymphoma in cats (3). Interestingly, ocular manifestations are often the presenting lesions and the precursor to detection of systemic disease (3,11).

Establishing the immunologic phenotype and histologic classification is important for determining therapeutic strategies and prognosis for dogs with lymphoma. In cats, immunophenotyping does not provide prognostic information, but is useful to confirm a diagnosis of lymphoma in conjunction with histopathology (14–16). Canine and feline intraocular lymphomas are frequently of B-cell lineage (17,18). However, knowledge of therapeutic response of specific lymphoma subtypes in cats is limited (14,15,19). Testing for FeLV and FIV may also be important in determining potential cause and prognosis. FeLV-antigenemic cats have significantly shorter remission and survival times than FeLV-negative cats (16). Histologic grade is one of the most reliable prognostic factors and is the main factor used to develop a treatment (20). Low grade lymphoma is often referred to as small cell lymphoma and is associated with prolonged survival.

Chemotherapy is the mainstay of treatment for cats with lymphoma. Combination chemotherapy protocol such as COP (cyclophosphamide, vincristine, and prednisolone) or CHOP (cyclophosphamide, doxorubicin, vincristine, and prednisolone) are considered standard of care for cats with high grade lymphomas (lymphoblastic lymphoma). Approximately 50% to 70% of cats are expected to achieve a remission with such protocols. Achieving a complete remission is a reliable prognostic factor. Cats achieving a complete remission may live 1 year or longer, while partial responders and non-responders will usually only live a few months (21–23). Cats with low grade lymphoma (small cell lymphoma) are usually treated with a combination of chlorambucil and prednisolone and are expected to have a prolonged survival (20). Extranodal lymphomas represent a therapeutic challenge as the disease is localized at the time of diagnosis. Some cats may be cured with local therapies such as surgery and radiation, while others will go on to develop systemic disease. Nasal lymphoma in cats is a common form of extranodal lymphoma. Treatment with radiation (with or without chemotherapy) yields survival times close to 3 years (24). Biologic behavior with other forms of extranodal lymphomas is largely unknown in cats so that a combination of local therapy (such as surgery) to control the primary disease in combination with systemic therapy (chemotherapy) to prevent systemic progression of the cancer is often recommended.

In this case chemotherapy was recommended; however, the owner elected not to pursue this treatment. As the left eye was still visual and comfortable we continued symptomatic therapy with topical diclofenac, prednisolone acetate, and dorzolamide/timolol, q8h. Unfortunately, the cat died 5 months after initial presentation and no postmortem examination was completed to confirm the cause of death. Although multicentric lymphoma was not confirmed by our initial diagnostic evaluation in this cat, it is likely that systemic progression of the lymphoma may have resulted in death.

**References**

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