Article

Canadian veterinarians' use of analgesics in cattle, pigs, and horses in 2004 and 2005

Caroline J. Hewson, Ian R. Dohoo, Kip A. Lemke, Herman W. Barkema

Abstract — Anecdotal evidence suggests that many veterinarians may not use analgesics in livestock for routine surgical procedures or painful disease states. To investigate this, we conducted a national mail survey of a random sample of 1431 Canadian veterinarians (response rate, 50.1%). Questions primarily concerned veterinarians' analgesic usage for common surgeries and medical conditions in beef and dairy cattle, pigs, and horses, and attitudes toward pain management. More than 90% of veterinarians used analgesic drugs for equine surgeries, for cesarean section in sows and cows, and for bovine claw amputation and omentopexy. However, in these and other categories, the analgesics used were often inadequate, and many veterinarians did not give analgesics to young animals. When castrated, $< 0.001\%$ of piglets received analgesia, compared with 6.9% of beef calves and 18.7% of dairy calves ≤ 6 mo of age, 19.9% of beef calves and 33.2% of dairy calves > 6 mo of age, and 95.8% of horses. Respondents largely agreed that there are no long-acting, cost-effective analgesics available for use in livestock (median rating 8/10; interquartile range 4–9), and that the long or unknown withdrawal periods of some drugs outweighed the benefits of using them (median rating 7/10; interquartile range 4–9). The results indicate an urgent need for veterinarians to manage pain in livestock better. Continuing education would help, as would an increase in the number of approved, cost-effective analgesic drugs with known withdrawal periods.

Résumé — **Utilisation des analgésiques chez les bovins, les porcs et les chevaux par les vétérinaires canadiens en 2004 et 2005. Résumé.** Divers témoignages permettent de présumer que plusieurs vétérinaires pourraient ne pas utiliser d'analgésiques chez les bestiaux lors de procédures chirurgicales de routine ou lors d'épisodes maladifs douloureux. Afin d'étudier ces présomptions, nous avons procédé à une enquête postale nationale sur un échantillon de 1431 vétérinaires canadiens choisis au hasard (taux de réponse, 50,1 %). Les questions portaient particulièrement sur l'usage d'analgésiques par le vétérinaire lors de chirurgies et de problèmes médicaux courants chez les bovins de boucherie et laitiers, les porcs et les chevaux et sur les attitudes dans le contrôle de la douleur. Plus de 90 % des vétérinaires utilisaient des analgésiques pour les chirurgies équines, les césariennes porcines et bovines et pour l'amputation des onglons et l'omentopexie chez les bovins. Cependant, dans ces actes médicaux et dans certains autres, les analgésiques utilisés étaient souvent inadéquats et plusieurs vétérinaires n'en donnaient pas aux jeunes animaux. À la castration, $< 0,001$ % des porcelets recevaient une analgésie comparé à 6,9 % des veaux de boucheries et 18,7 % des veaux laitiers âgés de moins de 6 mois, 19,9 % des veaux de boucherie et 33,2 % des veaux laitiers âgés de plus de 6 mois et 95,8 % des chevaux. Les répondants étaient largement d'accord pour dire qu'il n'y avait pas d'analgésiques à longue action et d'un bon rapport coût-efficacité disponibles pour utilisation sur les bestiaux (estimation médiane de l'opinion 8/10; étendue interquantile 4–9) et que les désavantages reliés aux périodes de retrait longues ou inconnues de certaines drogues l'emportaient sur les bénéfices (estimation médiane de l'opinion 7/10; étendue interquantile 4–9). Les résultats montrent que les vétérinaires ont un urgent besoin de mieux contrôler la douleur des bestiaux. L'éducation continue pourrait être utile de même qu'une augmentation du nombre d'analgésiques approuvés, d'un bon rapport coût-efficacité et dont les périodes de retrait seraient connues.

(Traduit par Docteur André Blouin)

Can Vet J 2007;48:155–164

Sir James Dunn Animal Welfare Centre (C. Hewson), Department of Health Management (I. Dohoo, H. Barkema), Department of Companion Animal Studies (K. Lemke), Atlantic Veterinary College, University of Prince Edward Island, Charlottetown, Prince Edward Island C1A 4P3.

Address all correspondence and reprint requests to Dr. Kip Lemke; e-mail: klemke@upei.ca

Introduction

Pain can reduce animal well-being substantially and prolong the time needed for recovery from the underlying condition (1,2). Protracted pain results when analgesics are not used for routine surgical procedures, such as castration and dehorning (3–12). This might be predicted from knowledge of pathophysiology (2,13); however, research in the United Kingdom (UK) (14,15) and anecdotal evidence suggest that many veterinarians may not manage pain adequately in cattle. A survey of all members of the British Cattle Veterinary Association (*n* = 1370; response rate 22%) indicated that only 68% of respondents gave postoperative analgesic drugs to cows that underwent cesarean section (14). Preliminary results from a more recent survey of 2391 cattle veterinarians in the UK who were listed in a pharmaceutical company's database (response rate 25.7%) indicated that at least 96% of respondents gave local anesthesia to at least 99% of cattle undergoing cesarean section, claw amputation, or dehorning (15). However, nonsteroidal antiinflammatory drugs (NSAIDs) were given to only 50% of cows that underwent cesarean section, 55% of cases of claw amputation, and 1% of cases of dehorning (15). A survey of a convenience sample of 68 bovine veterinarians in the UK indicated that veterinarians would find it useful to have a formal method for assessing pain in practice (16).

Another UK study showed that the prevalence of analgesic usage in horses for castration and several medical conditions was variable (17). That survey was of 400 equine and mixed-practice veterinarians, randomly selected from the Royal College of Veterinary Surgeons' Directory of Veterinary Practices (response rate 25.5%) (17). In the case of castration, 13.6% of respondents reported not using analgesic drugs; it is not clear if those respondents might have used general anesthetics (17).

To our knowledge, there are no published reports of veterinarians' usage of analgesics for surgeries and medical conditions in farm animals and horses in North America. There have been surveys of the use of perioperative analgesics by veterinarians in companion animal practice in Canada (18,19), the United States of America (USA) (20), and elsewhere (21–24). Researchers in Ontario are completing a survey of dairy veterinarians' usage of analgesics for dehorning (S Millman, personal communication, 2005). In 2002, the Veterinary Drugs Directorate of Health Canada proposed to conduct a national study of drug use in farm animals, but the study has not been done (25). In the USA, the overall usage of NSAIDs in food animal practice was examined, but usage of NSAIDs for individual medical conditions or surgeries was not described (26).

The objectives of the present study were to describe Canadian veterinarians' use of analgesics in cattle, pigs, and horses; and to determine the factors influencing that use. This paper pertains to the 1st objective, and a subsequent paper will address the 2nd objective (27).

Materials and methods

The survey was conducted between October 2004 and April 2005. It followed the method used to assess perioperative use of analgesics in companion animals in 1994 and 2001 (18,19).

Sampling

The sampling frame was all veterinarians in Canada listed by the provincial licensing bodies as working with cattle, pigs, or horses. The lists from Saskatchewan, Alberta, and British Columbia did not specify each individual's type of work, so, for those provinces, all veterinarians listed as being in mixed or large animal practice were included in the sampling frame. The lists were obtained in August and September 2004 and checked for duplication of names within and between provinces.

The total sample size was 1431. This comprised all eligible veterinarians in Atlantic Canada (*n* = 174) and samples from each of the other 6 provinces. Those samples comprised the following: (i) where the information was available (not in Saskatchewan, Alberta, and British Columbia), all those veterinarians listed as working in purely swine practice (*n* = 84) or, with the exception of Ontario, in purely equine practice (*n* = 100); and (ii) a random sample of all other veterinarians (*n* = 1073). In the case of Ontario, equine veterinarians comprised 25% of all eligible veterinarians, so the random sample was drawn from the total of all veterinarians listed as doing equine, mixed, or purely cattle practice. The size of each random sample was calculated with the following assumptions: (i) an average frequency of analgesic usage of 25%, with estimates to be within 10 percentage points of the true value 95% of the time; (ii) in Saskatchewan, Alberta, and British Columbia, 30% of those surveyed would do only small animal practice; and (iii) a 65% response rate. The random samples were selected in proportion to the total number of eligible veterinarians in each province.

Questionnaire

The questionnaire (copy available on request) concerned the individual veterinarian, not his or her practice, and was in 4 sections. Section 1 solicited demographic information: age, sex, college, and year of graduation, further qualifications, type of practice, location of practice, number of veterinarians and animal health technicians in the practice, and percentage of working time that the respondent spent with each of dairy cattle, beef cattle, pigs, and horses. Section 2 concerned the veterinarian's use of analgesic drugs for surgical and medical conditions in the 4 animal groups (Table 1). These questions asked about the annual number of cases; the number of those cases to which the respondent gave analgesic drugs; the drugs used most commonly; the typical number of doses of each drug; and the veterinarian's rating of the average level of pain associated with the surgery or medical condition if no analgesic were given, on a scale of 1 (no pain) to 10 (worst pain possible). The questions did not distinguish between surgical techniques, such as surgical and rubber-ring castration, or between techniques of local anesthesia. Section 3 concerned the veterinarian's agreement, rated on a scale of 1 (Disagree) to 10 (Agree), with general statements about the use of analgesics in dairy cattle, beef cattle, pigs, and horses, and with particular statements about each of the following: nonsteroidal antiinflammatory drugs (NSAIDs), alpha-2 agonists, local anesthetics, opioids, and dissociative anesthetics (ketamine). The particular statements concerned withdrawal periods in meat and milk, human

Table 1. Surgical procedures and medical conditions investigated in a survey of Canadian veterinarians' use of analgesics in cattle, pigs, and horses

Dairy	Beef	Pigs	Horses
Surgical procedures			
Castration up to 6 mo old[a]	Castration up to 6 mo old[a]	Castration up to 3 wk of age	Castration (routine)[b]
Castration over 6 mo old[a]	Castration over 6 mo old[a]	—	Castration (cryptorchid)
Cesarean section	Cesarean section	Cesarean section	—
Claw amputation		Ear notching	—
Dehorning up to 6 mo old[a]	Dehorning up to 6 mo old[a]	Inguinal hernia repair[b]	Inguinal hernia repair[b]
Dehorning over 6 mo old[a]	Dehorning over 6 mo old[a]	Tail docking	—
Omentopexy	—	—	—
Umbilical hernia repair up to 3 mo old	Umbilical hernia repair up to 3 mo old	—	Umbilical hernia repair[b]
Medical conditions			
Acute toxic mastitis	—	—	—
Acute lameness in cows (onset within last 48 h)	—	—	—
Chronic lameness in cows (onset more than 48 h previously)	—	Chronic lameness in sows[c]	Dentistry — extraction
Dystocia (nonsurgical)	Dystocia (nonsurgical)	—	Dentistry — floating
Corneal ulcer	Corneal ulcer	—	Corneal ulcer

[a] Method not specified
[b] Age not specified
[c] Time of onset not specified

abuse potential, side effects, and the need for record-keeping, as appropriate. Section 4 concerned continuing education (CE) in pain management, including a question in which respondents were asked to rank the utility of 9 different sources of knowledge about recognition and control of perioperative pain, and a question in which respondents were asked to rank 8 different forms of CE. Rankings were on a scale from 1 (most useful) to 8 or 9 (least useful). There were also 2 closed-ended questions that asked, for the pertinent animal groups, for the year when the respondent had last attended CE in pain management, and whether the respondent considered his or her knowledge of pain management to be adequate. Adequate was defined as "sufficient to enable you to take good care of your patients."

The questionnaire was pretested on a sample of 10 anglophone practitioners from across Canada. Their comments resulted in minor changes. The questionnaire was then translated into French and pretested by 3 francophone veterinarians, after which minor modifications were made. Cover letters were also translated for use with the French questionnaire for all francophones in the sample. Pretesting indicated that the questionnaire took 30 to 45 min to complete. Veterinarians who participated in the pretest were not included in the study sample.

Data collection and analysis

Following approval of the project by the University of Prince Edward Island Research Ethics Board, a letter advising about the survey, confidentiality, and voluntary participation was sent to all veterinarians selected for the study. One to 2 wk later, the questionnaire and a covering letter were sent with a stamped addressed return envelope. Three weeks after that, nonresponders received a facsimile reminding them of the survey. After a further 3 to 4 wk, anglophone nonresponders were telephoned and francophone nonresponders were sent another facsimile. Veterinarians in Atlantic Canada and Ontario were surveyed in October 2004; those in Quebec, in November 2004; and those in all the western provinces, in January 2005.

All respondents received a letter of thanks on receipt of their completed questionnaire. They were later sent a summary of the findings.

The veterinarians' names did not appear on the questionnaires, and all the data were managed and analyzed without identifying the respondents. The data were entered in a database management program (Epidata; Odense, Denmark) and checked. Descriptive statistics were generated by using a statistics program (Stata 8; Stata Corporation, College Station, Texas, USA). Estimates of analgesic use from the non-Atlantic provinces were weighted according to the number of eligible veterinarians in each province represented by 1 completed questionnaire. We adjusted estimates from the Atlantic provinces for finite populations. Simple *post hoc* comparisons were made as indicated by the data, using the chi-squared (χ^2) and the Kruskal-Wallis tests, with the Bonferroni correction for multiple testing, as appropriate.

Results

Eighteen percent (258/1431) of those sampled indicated that they were not currently in large animal practice in Canada; 4 others were listed in duplicate. A further 586 veterinarians completed questionnaires. Thus, the effective response rate was 50.1% (586/(1431-258-4). Of the 586 questionnaires returned, 1 was rejected because it was grossly incomplete. The remainder of the samples (*n* = 583) were nonresponders. Of these, 346 did not respond in any way, 149 indicated that they did not wish to participate, and 88 had moved or could not otherwise be contacted.

Demographic data are presented in Table 2. The majority of respondents were males and their mean (standard deviation (s); 95% confidence interval [95% CI]) age was 46.0 (0.51; 45.0, 47.0) y; the mean age of the women was 36.3 (0.53; 35.3, 37.4) y. Approximately half of the respondents (55%) worked in practices that were at least 75% large animal; 35% worked in practices that were between 25% and 75% large animal; and

Table 2. Demographic characteristics of 585 Canadian veterinarians responding to a survey of analgesic use in large animals in 2004/05, compared with 326 veterinarians who participated in a similar survey for companion animals in 2001

Characteristic	Large animal survey	Small animal survey (19)
Sex	65% male 35% female	39% male 61% female
Age	40% under 40 y of age	55% under 40 y of age
Years since graduation	33% graduated within the past 10 y	43% graduated within the past 10 y
School of graduation	9% Atlantic Veterinary College 29% Ontario Veterinary College 36% Western College of Veterinary Medicine 23% Faculté de médecine vétérinaire 6% United States or elsewhere	27% Atlantic Veterinary College 38% Ontario Veterinary College 17% Western College of Veterinary Medicine 11% Faculté de médecine vétérinaire 7% United States or elsewhere
Region	11% Atlantic Canada 22% Quebec 22% Ontario 45% Western Canada	50% Atlantic Canada 8% Quebec 23% Ontario 18% Western Canada
Practice size	52% with 1–3 veterinarians	63% with 1–3 veterinarians
Practices with animal health technologists (AHTs)	72% employ at least 1 AHT	85% employ at least 1 AHT

10% worked in practices that were less than 25% large animal. The mean (s; 95% CI) percentages of the respondents' work that involved each group of animals were as follows: dairy, 25.1 (1.4; 22.2, 27.9) %; beef, 16.9 (0.95; 15.1, 18.8) %; pigs, 6.0 (0.9; 4.3, 7.8) %; and horses, 26.2 (1.5; 23.4, 29.1) %. Fewer than 5% of respondents did all their work with only 1 of the 3 types of food animal; 15% worked only with horses.

Analgesic use

Seventeen respondents had graduated in 2004; therefore, they could not provide true estimates of the number of cases seen annually. These respondents comprised only 2.9% of the respondents, so their data were included without adjustment. There was a dichotomous distribution of analgesic use for many of the surgeries and medical conditions: veterinarians tended to give analgesics either to all cases or to none, as illustrated in the case of dehorning, shown in Figure 1. However, there was a more uniform distribution of analgesic use for the following: acute and chronic lameness in dairy cows (Figure 2); umbilical hernia repair in dairy calves, which some veterinarians indicated that they repaired nonsurgically in some cases; dystocia in dairy and beef cows; chronic lameness in sows; and dental floating in horses.

Tables 3–6 show the monthly caseloads of each surgery or medical condition, the usage of analgesic drugs, and the mean pain ratings. Analgesic usage was 80% or higher for many surgeries, particularly in horses (Tables 3–6). However, there were some differences in analgesic usage between animal groups, most notably in the case of castration (Tables 3–6). When calves up to 6 mo were castrated, the proportion of veterinarians that gave analgesics to all beef calves was no different than that for dairy calves (χ^2 = 1.3, P = 0.26). However, among calves over 6 mo, the proportion of respondents providing analgesia was significantly lower for beef calves than for dairy calves (χ^2 = 11.3, P = 0.001). Thirteen veterinarians who did not provide analgesia when castrating calves reported using an elastrator. The

proportion of veterinarians providing analgesia for dehorning was also significantly lower for beef calves than for dairy calves, both up to 6 mo old (χ^2 = 23.4, $P < 0.001$) and over 6 mo old (χ^2 = 13.4, $P < 0.001$). The effects of calf type and other factors on veterinarians' use of analgesics for dehorning are analyzed in the companion paper (27). There was also a difference in the prevalence of analgesic use for chronic lameness, nonusage being more likely for dairy cows than for sows (χ^2 = 13.4, $P < 0.001$).

Thirty-three respondents indicated that they did not provide any of the various analgesic drugs to all cows undergoing cesarean section (beef, n = 20; dairy, n = 11), or omentopexy (n = 14), or claw amputation (n = 4). (Total n exceeds 33, because 9 respondents were listed in 2 or more of the surgical categories in question). Ten of these veterinarians reported that they did not provide analgesia to any cases of at least 1 of the 3 surgeries. However, 5 of these 10 listed lidocaine in answer to the question about drugs used. In addition, 10 of the 33 veterinarians performed cesarean sections in both types of cattle — beef and dairy. Of these 10 respondents, 6 indicated that they did not provide analgesia to cows of one type, but did provide analgesia to all cows of the other type undergoing cesarean section. When the 33 veterinarians were examined by surgical category, at least 75% considered their knowledge of analgesia to be adequate, except in the case of claw amputation (33%).

Pain rating and drugs used

Procedures common to 2 or more groups were generally given similar pain ratings. The most noticeable species difference in pain rating was for routine castration: the mean pain rating in horses (7.4) (Table 6) was at least 1.5 units higher than that in dairy calves (Table 3), beef calves (Table 4), and piglets (Table 5) (Kruskal-Wallis P = 0.0001). Four respondents commented that castration of calves was less painful by rubber band than by surgery, and 2 respondents specifically rated the
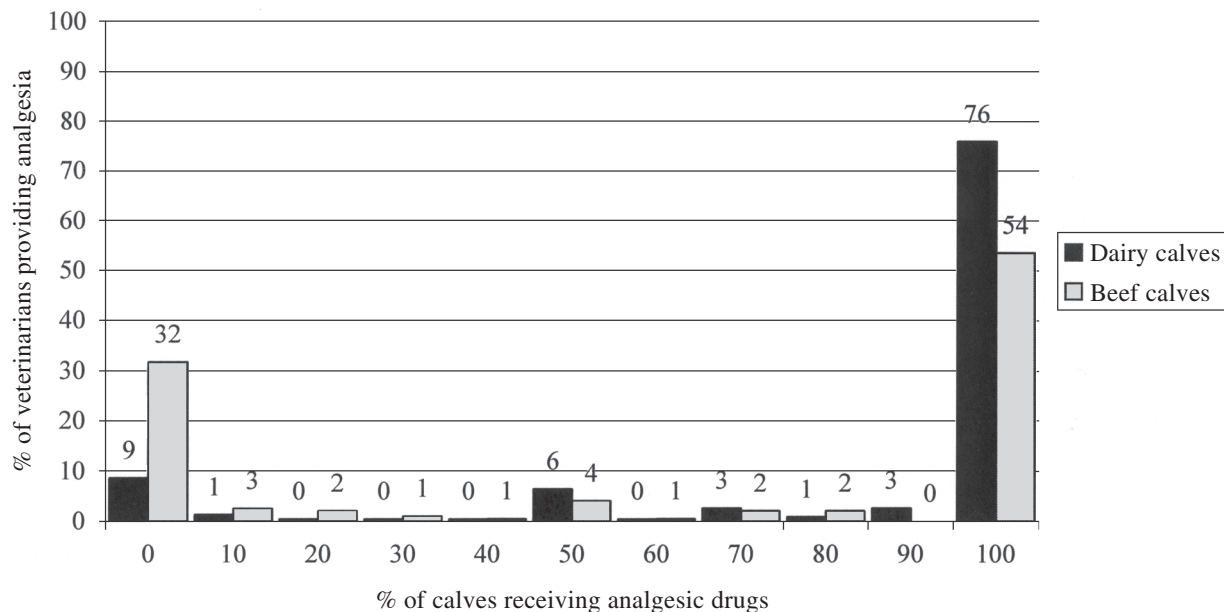
Figure 1. Distribution of Canadian veterinarians according to the percentages of beef and dairy calves up to 6 mo old that received analgesic drugs when undergoing dehorning.
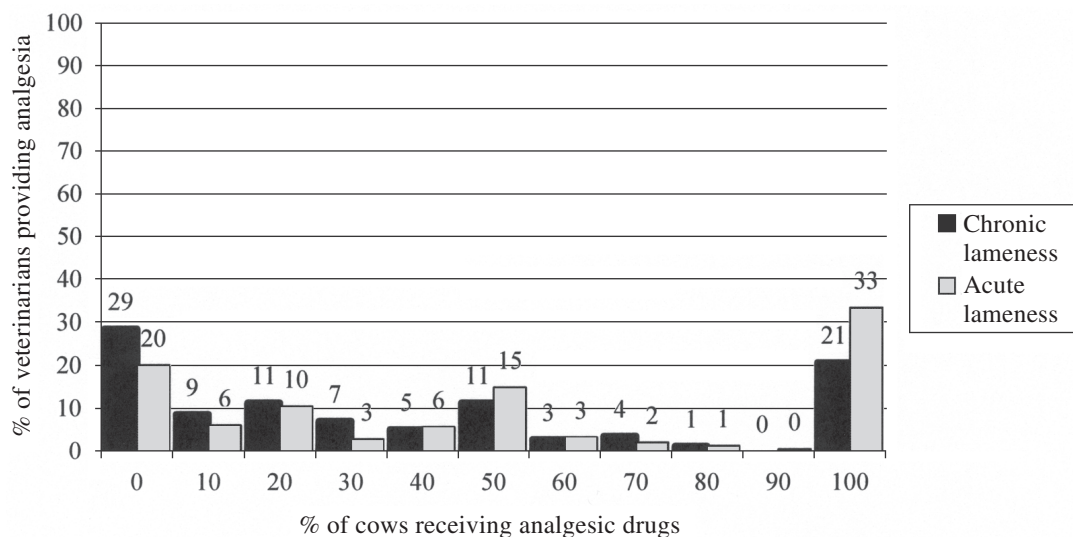
Figure 2. Distribution of Canadian veterinarians according to the percentages of dairy cattle with acute or chronic lameness that received analgesic drugs.

pain caused by rubber band castration as 1 (no pain). The most commonly used drugs are listed in Tables 3 to 6. In the case of food animals, some veterinarians specified that they used epidural or paravertebral anesthesia for dystocia, cesarean section, and omentopexy. Fewer than 10% of respondents used general anesthetics for any of the surgical procedures; most of these veterinarians also provided analgesia. Overall, among each of the 4 animal groups, at least 70% of respondents who provided analgesia used only 1 drug. For each surgery, up to 10 of these veterinarians used only an NSAID or butorphanol. Among those respondents who provided more than 1 drug, the drugs used were usually of different classes; NSAIDs were rarely used for any of the calf surgeries.

Opinions about analgesic use

There was no substantial concern about using any of the 5 classes of analgesic drugs in any of the animal groups (median ratings < 5). The exceptions were concern about long or unknown withdrawal periods for opioids and dissociative anesthetics in farmed animals (median 7; interquartile (IQ) range 3–8). Most respondents agreed very strongly that the use of analgesics increased their own safety (median 10; IQ range 6–10). There was also quite strong agreement that long-acting and cost-effective analgesic drugs for food animals (median 8; IQ range 4–9) are needed. For each of the farmed species, respondents did not have strong opinions about whether "Owners are unwilling to

Table 3. Annual caseloads of selected surgeries and medical conditions in dairy cattle, the associated usage of analgesics, and ratings of pain if no analgesic were given

Surgery or medical condition	Number of vets who reported seeing cases	Mean (s)[a] caseload per vet per year	Mean (95% CI)[b] percent of vets providing analgesia to some or all cases	Mean (95% CI)[b] percent of animals receiving analgesia	Analgesic drugs administered most commonly (%)	Mean (95% CI)[b] pain level, from 1 to 10, if no analgesic given
Castration up to age 6 months	167	31.8 (45.6)	19.1 (13.5–24.6)	18.7 (17.8–19.6)	Xylazine (54) Lidocaine (29)	4.6 (4.3–4.9)
Castration over age 6 months	105	15.0 (17.3)	48.1 (38.3–57.8)	33.2 (30.9–35.4)	Xylazine (62) Lidocaine (25)	5.9 (5.4–6.4)
Umbilical hernia repair up to age 3 months	214	5.9 (6.3)	94.2 (90.9–97.4)	96.0 (94.9–97.1)	Ketamine (36.4) Lidocaine (29.2)	7.2 (6.8–7.6)
Dehorning up to age 6 months	236	159.1 (256.6)	85.0 (80.9–89.1)	90.2 (90.0–90.5)	Lidocaine (67) Xylazine (29)	7.2 (6.9–7.5)
Dehorning over age 6 months	211	36.6 (45.5)	84.7 (80.5–89.4)	84.8 (84.1–85.4)	Lidocaine (58) Xylazine (36)	7.6 (7.3–8.0)
Cesarean section	321	8.0 (11.4)	97.1 (95.4–98.9)	98.5 (98.0–98.9)	Lidocaine (60) Ketoprofen (13)	7.8 (7.5–8.1)
Displaced abomasum (omentopexy)	314	40.4 (50.6)	96.8 (95.1–98.6)	96.9 (96.6–97.2)	Lidocaine (59) Xylazine (13)	7.2 (6.9–7.6)
Claw amputation	96	2.9 (4.1)	98.0 (92–99.9)	97.1 (95.3–99.0)	Lidocaine (44) Xylazine (28)	8.5 (8.0–9.0)
Acute toxic mastitis	309	26.4 (40.7)	93.3 (90.8–95.7)	95.7 (95.4–96)	Ketoprofen (40) Flunixin (32)	5.4 (5.2–5.7)
Acute lameness (cows)	258	35.2 (54.4)	52.1 (47.2–57)	33.3 (32.5–34.1)	Ketoprofen (42) Aspirin (16)	6.4 (6.2–6.7)
Chronic lameness (cows)	269	39.9 (48.7)	39.9 (35.3–44.5)	29.7 (29.0–30.3)	Ketoprofen (29) Aspirin (23)	5.2 (5.0–5.4)
Dystocia	334	39.4 (47.9)	33.9 (30.3–37.5)	26.5 (26.1–26.9)	Lidocaine (33) Ketoprofen (27)	5.3 (5.1–5.5)
Corneal ulcer	191	11.3 (37.3)	33.5 (27.2–39.9)	28.4 (26.8–30.1)	Ketoprofen (25) Lidocaine (20)	5.4 (5.1–5.7)

[a] s = standard deviation
[b] CI = confidence interval

pay for analgesia." Those working with beef cattle were neutral (median 5; IQ range 2–8); those working with dairy cattle disagreed somewhat (median 3; IQ range 1–6); and those working with pigs agreed slightly (median 6; IQ range 2–8). However, respondents strongly disagreed that horse owners are unwilling to pay (median 1; IQ range 1–3). Ratings for all food animals were also neutral on whether "The cost of analgesic drugs prohibits me from using them" (median 5; IQ range 2–8). In the case of cattle, respondents generally disagreed that "There are very few analgesic drugs approved for use in these animals, so I can't easily provide analgesia for my patients" (median 2; IQ range 1–4). In the case of pigs, respondents were neutral (median 5; IQ range 2–9). Three respondents expressed concern about the additional cost of the professional time spent waiting for local anesthesia to take effect.

Attitudes towards education in pain management

The time of veterinarians' most recent attendance at CE about analgesia varied. Among 353 veterinarians who treated dairy cattle, 300 had graduated in 2000 or earlier (at least 4 y before the survey was conducted); 27% (81/300) had never attended CE for pain management in dairy animals, and 61% (184/300)

had attended such CE in or after 2000. A similar analysis of those treating beef animals indicated figures of 29% (98/342) and 62% (213/342), respectively; for pigs, 60% (65/109) and 31% (34/109), respectively; and, for horses, 25% (95/383) and 65% (229/383), respectively. Among veterinarians who had graduated in 2000 or earlier, a majority (dairy, 79%; beef, 78%; and horses, 84%) considered their knowledge of pain control in that species to be adequate, but only 32% of the pig veterinarians considered their knowledge to be adequate. Perceived adequacy of knowledge did not appear to be associated with recent attendance (2000 or later) at CE (dairy, χ^2 = 2.3; P = 0.13; beef, χ^2 = 0.04; P = 0.83; pigs, χ^2 = 0.38, P = 0.54; and horses, χ^2 = 5.6; P = 0.018). The most important sources of knowledge about analgesic use and the preferences for different forms of CE are described in Table 7. Experience gained while in practice and discussions with other veterinarians were both ranked highly as sources of knowledge. Both lectures and wet labs at the provincial or regional level, and review articles in journals were the most highly rated forms of CE.

Discussion

The demographic characteristics of the responders differ somewhat from those of veterinarians working with companion

Table 4. Annual caseloads of selected surgeries and medical conditions in beef cattle, the associated usage of analgesics, and ratings of pain if no analgesic were given

Surgery or medical condition	Number of vets who reported seeing cases	Mean (s)[a] caseload per vet per year	Mean (95% CI)[b] percent of vets providing analgesia to some or all cases	Mean (95% CI)[b] percent of animals receiving analgesia	Analgesic drugs administered most commonly (%)	Mean (95% CI)[b] pain level, from 1 to 10, if no analgesic given
Castration up to 6 months of age	285	76.5 (121.7)	15.4 (11.6–19.2)	6.9 (6.7–7.2)	Xylazine (54) Lidocaine (27)	4.9 (4.6–5.1)
Castration over 6 months of age	306	38.6 (58.0)	35.1 (30.0–40.2)	19.9 (19.2–20.5)	Xylazine (52) Lidocaine (35)	5.9 (5.7–6.2)
Umbilical hernia repair in calves up to 3 months of age	159	4.7 (4.6)	96.9 (94.4–99.4)	97.2 (96.1–98.2)	Xylazine (30) Lidocaine (27)	7.3 (6.9–7.6)
Dehorning up to 6 months of age	209	48.4 (68.1)	60.5 (54.0–66.9)	57.5 (56.6–58.4)	Lidocaine (73) Xylazine (25)	6.8 (6.5–7.2)
Dehorning over 6 months of age	267	28.7 (51.6)	72.3 (67.2–77.4)	68.7 (67.8–69.7)	Lidocaine (67) Xylazine (28)	7.4 (7.1–7.6)
Cesarean section	369	21.2 (27.5)	95.9 (94.0–97.8)	95.6 (95.2–96.1)	Lidocaine (62) Xylazine (10)	8.0 (7.7–8.2)
Dystocia	388	35.5 (46.4)	38.2 (34.6–41.8)	33.8 (33.3–34.3)	Lidocaine (48) Ketoprofen (18)	5.3 (5.1–5.5)
Corneal ulcer	231	11.0 (15.1)	43.0 (36.8–49.1)	38.9 (37.1–40.7)	Lidocaine (34) Xylazine (15)	5.5 (5.2–5.8)

[a] s = standard deviation
[b] CI = confidence interval

Table 5. Annual caseloads of selected surgeries and medical conditions in pigs, the associated usage of analgesics, and ratings of pain if no analgesic were given

Surgery or medical condition	Number of vets who reported seeing cases	Mean (s)[a] caseload per vet per year	Mean (95% CI)[b] percent of vets providing analgesia to some or all cases	Mean (95% CI)[b] percent of animals receiving analgesia	Analgesic drugs administered most commonly (%)	Mean (95% CI)[b] pain level, from 1 to 10, if no analgesic given
Castration up to 3 weeks of age	21	24 535 (75 027)	11.1 (0–25.0)	< 0.001 (0)	Xylazine (20) Lidocaine (20)	4.7 (3.9–5.5)
Inguinal hernia repair	52	94.5 (326.5)	85.5 (75.7–95.4)	46.3 (44.9–47.7)	Lidocaine (30) Ketamine (25)	7.0 (6.4–7.7)
Ear notching	2	250 000 (353 553)	0	0	N/A	3.2 (1.6–4.8)
Tail docking	5	156 001 (218 928)	0	0	N/A	4.6 (3.4–5.7)
Cesarean section	19	3.9 (4.5)	100	100	Lidocaine (47) Ketamine (15)	7.6 (6.3–8.9)
Chronic lameness (sows)	31	251.8 (601.7)	65.2 (49.1–81.4)	84.9 (84.3–85.6)	Ketprofen (24) Flunixin (21)	5.4 (4.9–6.0)

[a] s = standard deviation
[b] CI = confidence interval

animals in Canada (19). There were more men and they were older in the present study than those in the companion animal study (19). There were also fewer graduates from the Atlantic Veterinary College in the present study, in part because the required sample size in the present study was larger than that for the companion animal study and had relatively fewer veterinarians from the Atlantic provinces (19).

The surgical procedures and medical conditions were chosen because of their certainty of being painful. The exception was dental floating, which might account for some of the reported nonuse of analgesia in this group. The results showed that not all respondents managed the pain in question. However, almost all respondents provided some form of analgesia to horses undergoing the surgeries concerned, and to cattle for the most invasive surgeries and the dehorning of dairy calves. The high use of analgesics for all these surgeries would have benefited the animals concerned, even if a primary reason for providing analgesia may have been to keep the animal still and thus protect the veterinarian. This legitimate motivation is suggested by the following: respondents' strong agreement that using analgesia made it safer to work with the species concerned; the almost universal use of analgesia, particularly xylazine and ketamine, for equine surgeries; and xylazine, not lidocaine, being the most commonly used drug for calf castrations. However, the benefit to animals of the high levels of analgesic usage is unlikely to have been optimal, because most analgesic users used only

Table 6. Annual caseloads of selected surgeries and medical conditions in horses, the associated usage of analgesics, and ratings of pain if no analgesic were given

Surgery or medical condition	Number of vets who reported seeing cases	Mean (s)[a] caseload per vet per year	Mean (95% CI)[b] percent of vets providing analgesia to some or all cases	Mean (95% CI)[b] percent of animals receiving analgesia	Analgesic drugs administered most commonly (%)	Mean (95% CI)[b] pain level, from 1 to 10, if no analgesic given
Castration (routine)	408	25.2 (30.3)	97.4 (95.9–98.9)	95.8 (95.4–96.2)	Xylazine (30) Ketamine (28)	7.4 (7.2–7.6)
Castration (cryptorchid)	117	5.7 (7.5)	98.4 (96.2–100)	97.9 (96.9–98.9)	Xylazine (25) Ketamine (23)	7.7 (7.2–8.1)
Umbilical hernia repair	194	5.2 (8.6)	96.1 (93.3–98.8)	92.0 (90.3–93.6)	Xylazine (31) Ketamine (29)	6.4 (6.0–6.8)
Inguinal hernia repair	45	2.9 (3.4)	98.9 (89.3–100)	97.7 (92.8–100)	Xylazine (30) Ketamine (26)	6.7 (6.0–7.5)
Dentistry (extraction)	214	24.5 (45.8)	95.4 (92.9–98.0)	87.5 (86.8–88.2)	Butorphanol (30) Xylazine (24)	6.2 (5.8–6.5)
Dentistry (floating)	395	88.5 (154.9)	67.2 (63.3–71.1)	63.1 (62.6–63.6)	Xylazine (36) Butorphanol (33)	2.7 (2.5–2.9)
Corneal ulcer	298	9.8 (20.4)	77.8 (73.5–82.1)	80.4 (79.2–81.6)	Flunixin (27) Phenylbutazone (21)	6.0 (5.7–6.3)

[a] s = standard deviation
[b] CI = confidence interval

1 analgesic drug. This practice could not mitigate pain adequately because of the nature of the pain pathway and the short duration of action of the most commonly used drugs, such as lidocaine (13, 28). The use of butorphanol or NSAIDs alone, as reported by a minority of respondents, would not have provided effective perioperative analgesia.

In the cases of cesarean section, omentopexy, and claw amputation, a few veterinarians reported that they did not provide analgesia to cows undergoing these procedures. The inconsistencies in their replies suggest that several, in fact, provided analgesia to some or all of their cases; therefore, the estimated proportions of analgesic nonuse are overestimates for these procedures. Also, in the case of omentopexy, some of the apparent nonusers may have mistakenly provided data for nonsurgical approaches to displaced abomasum. Nevertheless, even a low level of nonuse for any of these surgical procedures is cause for particular concern.

In the case of routine elective surgeries, some nonusers may have believed that young animals generally do not require analgesia for dehorning or castration. Some indicated this to be their belief in the case of rubber ring castration. However, when performed without analgesia, surgical castration (3–8), rubber ring castration (3,4), and hot-iron dehorning (9–12) cause acute pain. These procedures also cause protracted pain lasting several days (8,12), or in the case of rubber-ring castration, several weeks (3). In the case of calves, a recent review recommended — erroneously in light of the pain associated with rubber-ring castration — "If only local anesthesia is to be used, maybe it should be limited to rubber-ring and latex-band castration, whereas both local anesthesia and ketoprofen are required for surgical or Burdizzo castration"(4). In the case of dehorning, the same authors recommended that, at a minimum, local anesthesia always be given to calves undergoing dehorning or disbudding (12). Although a relatively high proportion of veterinarians in our study used local anesthesia

when dehorning dairy calves, usage was much lower for beef calves, and usage of ketoprofen was very low. In comparison, at least 98% of UK veterinarians used local anesthesia in at least 99% of calves undergoing dehorning, but NSAIDs were almost never given (15). That report did not include data on castration (15). In the UK, the Protection of Animals (Anaesthetics) Act 1954 requires that anesthesia be used in all calves or cattle that undergo dehorning, with the exception of disbudding by chemical cauterization in calves less than 1 wk of age (29).

Our data suggest that a minority of respondents met the above recommendations for dehorning (4) or castrating (12) calves. The greater use of xylazine, rather than lidocaine, for castration may have arisen because of concern about the cost of the time needed for local anesthetics to take effect. Moreover, although respondents did not generally use ketoprofen or other NSAIDs in calves for castration or other surgeries, they disagreed that NSAIDs pose substantial health risks in cattle. While respondents were neutral about whether cost prevented them from using analgesic drugs, they agreed that there are not enough cost-effective, long-acting analgesic drugs. In the absence of concerns about risks to cattle, this suggests that cost may have dissuaded veterinarians from using ketoprofen in calves. Questions about the cost of individual drugs for each surgical procedure would have clarified this but would have made the questionnaire too long. In February 2006, we estimated that the cost of a single parenteral dose of ketoprofen (2 mg/kg body weight [BW]) or flunixin (1 mg/kg, BW) for a 100 kg calf is approximately $2. This might be considered costly in a depressed cattle industry. However, in addition to the humane benefits of using NSAIDs, their use with local anesthesia for dehorning or castration may help to sustain short- and long-term growth rates (4,10–12).

The differences between the animal groups in the prevalences of analgesic use for castration, dehorning, and chronic lameness

Table 7. Canadian veterinarians' rankings of sources of knowledge about analgesia in cattle, pigs, and horses, and of different sources of continuing education about analgesia

Item	Median (interquartile range)
Sources of knowledge about analgesia (ranks were assigned in descending order, from 1 to 9)	
Experience gained while in practice	2 (1,3)
Continuing education lectures	3 (2,4)
Discussion with other veterinarians	3 (2,5)
Journal articles	4 (3,6)
Undergraduate veterinary education	4 (1,6)
Textbooks	5 (3,6)
Internet	7 (6,8)
CD-ROMs	8 (7,8)
Postgraduate (university) education	9 (7,9)
Preferred form of continuing education (ranks were assigned in descending order, from 1 to 8)	
Lectures at the provincial or regional level	2 (1,3)
Review articles in journals	3 (2,5)
Wet labs at the provincial or regional level	3 (2,5)
Lectures at the national level	4 (2,6)
Wet labs at the national level	5 (4,7)
Internet (review articles or interactive materials)	5 (3,7)
Educational CD-ROMs	5 (4,7)
Educational videotapes	6 (4,8)

may reflect, in part, the different industry structures and the different economic worth of animals in each group. In particular, the levels of analgesic use for castration of calves and piglets were much lower than that for horses and were somewhat lower than the prevalence of postincisional use among dogs (38%) and cats (30%) undergoing castration (19). The extremely low prevalence of analgesic use for piglet castration is consistent with the incorrect assumption that young animals do not feel pain like adult animals, and with the perception that it is not practical to give pain relief to animals undergoing castration. Low levels of analgesic use in pigs are consistent also with the industry's narrow profit margins, and with its focus on herd health rather than the care of individual animals. That relatively more veterinarians treated chronically lame sows than treated chronically lame dairy cows may reflect producers' concern about milk withholding periods rather than producers' special consideration of sows.

No veterinarian who provided a rating indicated that any of the surgeries or conditions were painless. In the case of castration, the average pain rating for horses may have been up to 2 units higher than that in the survey by Price et al (17) who used a very similar question and an identical rating scale but reported the result differently. The higher rating in our study is consistent with the higher prevalence of analgesic use for equine castration (Table 6) compared with the 87% reported by Price et al (17). In the case of cattle, pain ratings for castration and the other surgeries were broadly similar to those reported in the UK (14–16), but in the order of 1 unit lower in some cases. However, the UK studies used different sampling frames and had lower response rates, and the reports did not include confidence intervals, so it is difficult to judge whether there are real differences from findings in Canada.

In our study, the higher pain rating for castration of horses compared with the other groups is consistent with horses being seen as companion animals; signs of pain in cattle being overlooked because cattle do not show pain very overtly for reasons of evolutionary fitness (30); and piglets and most calves being castrated at a younger age than colts, with respondents perceiving that younger animals suffer less pain than older ones. It has been argued that veterinarians' perception of the pain caused by castration in horses is inflated (31). However, it may rather be that veterinarians underrate the pain caused by castration in food animals, both because of the traditional discounting of pain in livestock and as a form of emotional self-defence in the face of the numbers of animals concerned and the perceived economic constraint on analgesic use (32).

Most of the veterinarians in our study who dealt with cattle and horses considered their knowledge of analgesia adequate, but most of those who worked with pigs considered their knowledge inadequate. The confidence of bovine and equine clinicians here contrasts with that recorded in surveys in the UK, in which only 45.5% of responding cattle veterinarians (15) and 62.9% of responding equine veterinarians (17) considered their knowledge of analgesia to be adequate. It is not clear if "adequate" was defined in the UK studies, and the other methodological differences limit comparison (15,17). There were similarities between our results and those in the UK (15,17) in the most highly rated sources of knowledge about analgesia. In both cases, experience gained while in practice and discussions with other colleagues were rated highest. Reliance on either source of knowledge is a concern in light of the common failure to provide adequate analgesia revealed in our study. The mistaken perception that rubber-ring castration is almost painless is a further case in point. Although our respondents rated CE and experience in practice as joint highest sources of knowledge, many respondents had not taken CE in food animal analgesia recently, and 1 respondent commented that it was not generally available in its own right. Our results indicate the need for more CE opportunities in food animal analgesia.

Sources of bias

The results must be interpreted in light of 5 potential sources of bias: coverage error, nonresponse error, sampling error, measurement error, and response biases (33,34). Coverage error is unlikely, as current registers from all licensing bodies were used. Regarding nonresponse error, the response rate was double that of comparable UK surveys (14,16), but it was lower than the 65% to 70% recommended as being representative for a professional group (33), which we provided for in our sample size estimation. However, the higher than predicted rate of analgesic use, in most categories, may have offset the lower than planned response rate. This is suggested by the generally narrow confidence intervals (Tables 3–6). Nonresponse may have been due to seasonal workload. The timing of the survey was based on the recommendations of practicing veterinarians in each region, and the length of the questionnaire was deemed acceptable by those in the pretest. However, some veterinarians indicated that they were too busy to participate and some respondents indicated that the questionnaire was too long.

Sampling error is not a concern because sampling was random, and appropriately sized samples were taken from each

province, with an allowance for subjects who did not work with the species of interest. Also, sampling probabilities were taken into account in the analyses. Measurement error was minimized by pretesting. While it was not possible to assess the validity of answers, 116 respondents agreed to complete the questionnaire again, 4–6 wk after first completing it, and 80% of these gave highly repeatable estimates of analgesic use and pain (unpublished data). Response biases (recall bias and social desirability or "faking good" biases) (34) were not assessed. Recall bias may have affected the validity of respondents' estimates, resulting in incorrect estimates of the prevalence of analgesic use. The risks of social desirability and "faking good" biases were minimized by assurances in the covering letter and questionnaire that we were not looking for right or wrong answers, and that the data were confidential. In light of all these efforts, our results may be said to be a reasonable representation of at least 50% of Canadian veterinarians who work with cattle, pigs, and horses.

In conclusion, the prevalence of analgesic use in our study, at the animal level, is almost certainly higher than the average for all animals nationally, in the case of those surgeries that are also performed by farmers (livestock castration, dehorning). Prevalence of analgesic use is also very high for the most invasive surgeries. However, for reasons of animal welfare and professional ethics, it remains a grave concern that so many veterinarians provided either no analgesia or inadequate analgesia to animals under their care (1). Stookey (35) has made the case for veterinarians to provide pain relief for routine surgeries in food animals, as has Landals who indicated that providing pain relief is his practice's policy (as quoted in reference 36). The results of this survey provide the profession with direction for achieving those minimum standards. We make the following recommendations: (i) CE about pain management in each of cattle, pigs, and horses should be widely available to veterinarians through review articles and regular regional or local lectures and wet labs; (ii) more cost-effective analgesics, with shorter withdrawal periods, should be developed or made available for use in food animals, so that multimodal analgesia is more feasible; (iii) licenses should be granted more readily for the use of longer-acting analgesic drugs in young animals that are not going to be part of the human food supply until they are much older; and (iv) the cost of pain relief in food animals should be incorporated into current food policy, rather than remaining one of many extrinsic costs of food provision.   CVJ

References

1. ACVA. American College of Veterinary Anesthesiologists' position paper on the treatment of pain in animals. J Am Vet Med Assoc 1998; 213:628–630.
2. Muir WW, Woolf CJ. Mechanisms of pain and their therapeutic implications. J Am Vet Med Assoc 2001;219:1346–1356.
3. Molony V, Kent JE, Robertson IS. Assessment of acute and chronic pain after different methods of castration of calves. Appl Anim Behav Sci 1995;46:33–48.
4. Stafford KJ, Mellor DJ. The welfare significance of the castration of cattle: A review. NZ Vet J 2005;53:271–278.
5. Weary DM, Braithwaite LA, Fraser D. Vocal response to pain in piglets. Appl Anim Behav Sci 1998;56:161–172.
6. Taylor AA, Weary DM. Vocal responses of piglets to castration: Identifying procedural sources of pain. Appl Anim Behav Sci 2000; 70:17–26.
7. Taylor AA, Weary DM, Lessard M, Braithwaite L. Behavioural responses of piglets to castration: The effect of piglet age. Appl Anim Behav Sci 2001; 73:35–43.
8. Hay M, Vulin A, Génin S, Sales P, Prunier A. Assessment of pain induced by castration in piglets: Behavioral and physiological responses over the subsequent 5 days. Appl Anim Behav Sci 2003;82:201–218.
9. Sylvester SP, Stafford KJ, Mellor DJ, Bruce RA, Ward RN. Behavioural responses of calves to amputation dehorning with and without local anaesthesia. Aust Vet J 2004;82:697–700.
10. Vickers KJ, Niel L, Kiehlbauch LM, Weary DM. Calf response to caustic paste and hot-iron dehorning using sedation with and without local anesthetic. J Dairy Sci 2005;88:1454–1459.
11. Faulkner PM, Weary DM. Reducing pain after dehorning in dairy calves. J Dairy Sci 2000;83:2037–2041.
12. Stafford KJ, Mellor DJ. Dehorning and disbudding distress and its alleviation in calves. Vet J 2005;169:337–349.
13. Lemke KA. Understanding the pathophysiology of perioperative pain. Can Vet J 2004;45:405–413.
14. Watts SA, Clarke KW. A survey of bovine practitioners' attitudes to pain and analgesia in cattle. Cattle Pract 2000;8:361–362.
15. Whay HR, Huxley JN. Pain relief in cattle: A practitioner's perspective. Cattle Pract 2005;13:81–85.
16. Fitzpatrick JL, Nolan AM, Scott EM, Harkins LS, Barrett DC. Observers' perceptions of pain in cattle. Cattle Pract 2002;10:209–212.
17. Price J, Marques JM, Welsh EM, Waran NK. Pilot epidemiological study of attitudes towards pain in horses. Vet Rec 2002;151:570–575.
18. Dohoo SE, Dohoo, IR. Postoperative use of analgesics in dogs and cats by Canadian veterinarians. Can Vet J 1996;37:546–551.
19. Hewson CJ, Dohoo IR, Lemke KA. Perioperative use of analgesics in dogs and cats by Canadian veterinarians in 2001. Can Vet J 2006;47:352–359.
20. Wagner AE, Hellyer PW. Survey of anesthesia techniques and concerns in private veterinary practice. J Am Vet Med Assoc 2000;217:1652–1657.
21. Capner CA, Lascelles BD, Waterman-Pearson AE. Current British veterinary attitudes to perioperative analgesia for dogs. Vet Rec 1999;145: 95–99.
22. Williams VM, Lascelles BD, Robson MC. Current attitudes to, and use of, peri-operative analgesia in dogs and cats by veterinarians in New Zealand. NZ Vet J 2005;53:193–202.
23. Raekallio J, Heinonen KM, Kuussaari J, Vainio O. Pain alleviation in animals: Attitudes and practices of Finnish veterinarians. Vet J 2003;165: 131–135.
24. Hugonnard M, Leblond A, Keroack A, Cadore JL, Troncy E. Attitudes and concerns of French veterinarians towards pain and analgesia in dogs and cats. Vet Anaesth Analg 2004;31:154–163.
25. Health Canada [homepage on the Internet]. Ottawa, ON: Health Canada. [updated 2003 April 9; cited 2006 Feb 18]. Health Canada's Veterinary Drug Directorate Drug Use in Animals Study — Update. Available from: www.hc-sc.gc.ca/dhp-mps/vet/label-etiquet/elu-ume_e.html Last accessed February 18, 2006.
26. Kopcha M, Kaneene JB, Shea ME, Miller RA, Ahl AS. Use of nonsteroidal anti-inflammatory drugs in food animal practice. J Am Vet Med Assoc 1992;201:1868–1872.
27. Hewson CJ, Dohoo IR, Lemke KA, Barkema HW. Factors affecting Canadian veterinarians' use of analgesics when dehorning beef and dairy calves. Can Vet J; submitted.
28. Anderson DE, Muir WW. Pain management in ruminants. Vet Clin North Am Food Anim Pract 2005;21:19–31.
29. Code of Recommendations for the Welfare of Livestock: Cattle. London: Defra Publ, 2003:30–31.
30. Philips C. Cattle Behaviour and Welfare. Oxford: Blackwell Publ, 2002:58.
31. Green P. Castration of horses and analgesia. Vet Rec 2001;149:159–160.
32. Byrne A, Morton J, Salmon P. Defending against patients' pain. A qualitative analysis of nurses' responses to children's postoperative pain. J Psychosom Res 2001;50:69–76.
33. Salant P, Dillman DA. How To Conduct Your Own Survey. New York: John Wiley, 1994;22:43–51.
34. Streiner DL, Norman GR. Health Measurement Scales: A Practical Guide to their Development and Use. New York: Oxford Univ Pr, 1995:72–75.
35. Stookey JM. The veterinarian's role in controlling pain in farm animals Can Vet J 2005;46:453–458.
36. Anon. Pain management in farmed animals. Attitudes are changing. Livest Welfare Insights 2002;3:1–2.