Perioperative pain management protocols of veterinarians in the United States for horses undergoing routine orchiectomy (castration)

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Abstract

Background: Analgesic protocols related to orchiectomy or castration of young horses vary widely depending on geographic location, educational background of the veterinarian, and other demographic factors. Specific practices of equine veterinarians in the United States (US) have not been reported. Objectives: To determine perioperative pain management practices of equine veterinarians in the US as they relate to castration of young male horses. Study Design: Cross-sectional survey Methods: An internet-based questionnaire included items related to analgesic drugs used in association with castration of healthy yearling colts. Demographic and educational factors associated with routine recommendation of analgesic medications after castration were analyzed using logistic regression. Results: Responses from 146 equine veterinarians in the US revealed that 112/146 (76.7%) administered a nonsteroidal anti-inflammatory drug (NSAID) at the time of castration. Routine recommendation of post-castration analgesia was associated with veterinarians who were employed in a multi-veterinarian practice, completed their veterinary education after 2000, and provided a higher pain severity score for horses at 24 hours after a routine castration. Main Limitations: Possible distribution, self-selection, response, and recall biases as a result of convenience sampling methodology. Conclusions: Perioperative pain management practices vary widely among US veterinarians but the majority of veterinarians, especially more recent graduates, recommend administration of an NSAID.

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RUNNING HEAD: Perioperative castration protocols of US veterinarians

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Summary

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Objectives: To determine perioperative pain management practices of equine veterinarians in the US as they relate to castration of young male horses.

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Methods: An internet-based questionnaire included items related to analgesic drugs used in association with castration of healthy yearling colts. Demographic and educational factors associated with routine recommendation of analgesic medications after castration were analyzed using logistic regression.

Results: Responses from 146 equine veterinarians in the US revealed that 112/146 (76.7%) administered a nonsteroidal anti-inflammatory drug (NSAID) at the time of castration. Routine recommendation of post-castration analgesia was associated with veterinarians who were employed in a multi-veterinarian practice, completed their veterinary education after 2000, and provided a higher pain severity score for horses at 24 hours after a routine castration.

Main Limitations: Possible distribution, self-selection, response, and recall biases as a result of convenience sampling methodology.

Conclusions: Perioperative pain management practices vary widely among US veterinarians but the majority of veterinarians, especially more recent graduates, recommend administration of an NSAID.

Clinical relevance:

- Most US veterinarians (76.7%) recommend administration of a nonsteroidal anti-inflammatory analgesic to horses after routine castration.
- Veterinarians who are employed in a multi-veterinarian practice, completed their veterinary education after 2000, and consider horses to be experiencing a higher degree of pain at 24 hours after a routine castration are more likely to routinely recommend analgesia after castration of a yearling colt.
- The majority of US veterinarians prefer recumbent castration to standing castration protocols.

Introduction

In 2001, a letter to the editor of *Veterinary Record* from an experienced equine practitioner suggested that horses experience little or no pain after castration and questioned the routine administration of postoperative analgesic medications for all equine castrations. (Green, 2001) This conclusion was based on their lack of observed obvious behavioral signs of inguinal or abdominal pain (sweating, rolling, stretching, etc.) after castration. Rebuttal letters from equally experienced equine practitioners argued that horses do, indeed, experience significant pain after castration, but that pain is manifest in more subtle behaviors. (Capner, 2001; Harris, 2001; Jones, 2001)

In the 20 years since that exchange of opinions, there have been notable advancements in recognition of behavioral manifestations of pain in horses including development and validation of a variety of tools to assess and "measure" pain behaviors in horses. These include composite pain scales (Gleerup and Lindegaard, 2016; Maskato et al., 2020; Pritchett et al., 2003; Sutton et al., 2013; Taffarel et al., 2015; van Loon et al., 2014; van Loon and Van Dierendonck, 2015; VanDierendonck and van Loon, 2016), facial expression-based pain scales (Dalla Costa et al., 2014; Dalla Costa et al., 2016; Maskato et al., 2020; Pritchett et al., 2013; Taffarel et al., 2020; Sutton et al., 2014; Dalla Costa et al., 2016; Maskato et al., 2020; Pritchett et al., 2003; Sutton et al., 2016; Maskato et al., 2020; Pritchett et al., 2003; Sutton et al., 2013; Taffarel et al., 2015; van Loon and Van Dierendonck, 2015; VanDierendonck, 2015; VanDierendonck and van Loon, 2016), and ethograms of pain-associated behaviors in stabled and ridden horses (Dyson and Ellis, 2022; Dyson and Pollard, 2020, 2021a, 2021b, 2022).

Several equine pain behavior instruments have been used to evaluate pain experienced by horses after routine castration procedures with the general conclusion that there are differences in behavior of horses after castration that may be modified or ameliorated with administration of analgesic medications. (Dalla Costa et al., 2021; Dalla Costa et al., 2014; Lawson et al., 2020; Lemonnier et al., 2022; Lencioni et al., 2021; Sanz et al., 2009; Taffarel et al., 2015; Trindade et al., 2021; van Loon et al., 2010) In a 2020 survey of equine veterinarians in the United States (US), respondents were asked to rate the degree of pain experienced by a yearling colt 24 hours after a routine castration was performed, assuming no analgesia was provided after

the procedure, using a numerical rating scale of 0 (no pain at all) to 10 (worst possible pain). (Sellon, Sanz, Kopper, et al., 2022) Responses ranged from 1 to 10 with a median score of 5 and interquartile range of 4 to 7. This is very similar to responses from previous surveys of equine veterinarians in the Netherlands and Belgium (Dujardin and van Loon, 2011), the United Kingdom (Price et al., 2002), and Brazil (Lorena et al., 2013).

The goal of this study was to determine pain management practices of equine veterinarians in the US, specifically as they relate to perioperative care associated with castration of young male horses. We hypothesized that most veterinarians would prescribe nonsteroidal anti-inflammatory drugs (NSAIDs) for a minimum of 3 days after surgery and that the lack of recommendation of postoperative analgesia would be associated with year of graduation.

Materials and Methods

Questionnaire. The Institutional Review Board of Washington State University determined this project satisfied the criteria for exempt research. An internet-based questionnaire for veterinarians, designed on a commercial internet survey site (Qualtrics, Provo, UT), consisted of 8 sections: introduction, attitudes and beliefs related to pain and pain management, assessment of pain severity, analgesic drugs, castration protocols, subsolar abscess protocols, characteristics of current employment and demographics including veterinary education and training. Responses related to assessment of pain severity (on a scale of 0 indicating no pain to 10 indicating the worst possible pain), castration protocols, characteristics of current employment, and respondent demographics were included in this analysis. Separate reports compared pain severity scores for common equine disorders as provided by equine veterinarians to scores provided by horse owners (Sellon, Sanz, Kopper, et al., 2022) and examined the acquisition and use of analgesic drugs by horse owners. (Sellon, Sanz, and Kopper, 2022) Invitations to participate in the survey were distributed through electronic mail lists and social media sites for equine veterinarians. Participation was initiated by clicking on a hyperlink that directly accessed the questionnaire.

Data analysis. All statistical analyses were performed using commercial statistical software (SigmaStat 4.0, Systat Software, Inc., San Jose, CA) with significance determined at P < 0.05 unless specified otherwise. Responses to each demographic, educational, and experiential item were summarized separately. Descriptive statistics were determined as appropriate based on data distribution patterns and included mean with standard deviation, median with 25th and 75th quartiles (IQR), and 95% confidence intervals (CI).

Respondents were categorized into groups designated Post-Castration Analgesia (one or more NSAID medications) and No Post-Castration Analgesia (no analgesia of any type) based on whether or not analgesia was recommended after routine castration of a healthy yearling colt. Categorical variables from the demographic, educational, and experiential sections of the questionnaires were compared between these groups using Chi-square analysis with calculation of odds ratios (OR) and 95% CI. Continuous variables were compared between groups using a Mann-Whitney rank sum test (MWRS). Categorical and continuous variables with P < 0.1 in univariate analysis were included in backward stepwise analysis to identify a subset of independent predictors that were significantly associated with the dependent variable of post-castration analgesia. Independent variables identified in the backward stepwise analysis were included in calculation of a final multivariable logistic regression model.

Results

Questionnaire responses. A total of 343 equine veterinarians accessed the questionnaire. Data from 97 respondents were removed from the analysis because they failed to complete the survey and did not provide pain scores for all scenarios. Data from an additional 63 respondents were removed from analysis because they did not confirm that they practiced in the US and 37 respondents were removed because they indicated that they did not perform castrations. The final data set, therefore, included responses from 146 veterinarians practicing in the US who performed castration surgeries on horses (Figure 1).

Castration protocols. Of all respondents, 127 (87.0%) preferred recumbent castrations and 19 (13.0%)

preferred standing castrations. At the time of castration, NSAIDs were administered by the majority of respondents (112/146, 76.7%). Lidocaine was injected into the testicles or spermatic cord at the time of surgery by 110 respondents (75.3%).

There was no difference in frequency of NSAID administration at time of surgery, testicular or spermatic cord injection of lidocaine at time of surgery, or recommendation of NSAIDs after surgery between individuals who preferred recumbent approaches to castration and those who preferred standing approaches. There were 10 respondents (6.8%) who indicated that they provided none of these three types of analgesia at the time of, or after, routine castration. Of these 10 respondents, 8 completed their veterinary education prior to 2000 and 6 worked as solo practitioners. The median pain score for post-castration horses provided by these respondents was 4 (range = 2 - 8).

Of all respondents, 107 (73.3%) recommend some type of analgesic medication for treatment of healthy yearling colts after routine castration surgery. One or more NSAIDs were recommended for administration after surgery by 107 respondents (73.3%); duration of administration varied from 1 to 7 days (Figure 2). The most commonly recommended NSAIDs were phenylbutazone (n = 77/112, 68.8%) and flunixin meglumine (n =55, 49.1%). Five respondents indicated that they recommended firocoxib for some patients. (Respondents were permitted to select multiple types of NSAIDS.) Xylazine and butorphanol were indicated as postoperative analgesic medications by one respondent each, both of whom also indicated that they recommended administration of an NSAID.

Veterinarians who recommended postoperative analgesic medications after routine castration surgery provided a higher median pain score for horses after castration as compared to those who did not make this recommendation (median values of 6 and 4, respectively, P < 0.001). The odds ratio and 95% CI for categorical variables related to post-operative analgesia recommendations are shown in Table 1. Variables with a P < 0.1 which were included in backwards stepwise regression included pain severity score for horses after castration, employment in a multi-veterinarian practice, gender, and year of completion of veterinary degree (before or after 2000). The variable of graduation year was a forced variable. Significant variables included in the final logistic regression analysis included employment in a multi-veterinarian practice, graduation year, and pain severity score for horses after castration with the final model shown in Table 2. The Likelihood ratio test statistic for this model was 26.422 (P < 0.001) with a Hosmer-Lemeshow statistic of 6.075 (P = 0.639).

Discussion

In this study, routine recommendation of post-castration analgesia was associated with veterinarians who were employed in a multi-veterinarian practice, completed their veterinary education after 2000, and provided a higher pain severity score for horses at 24 hours after a routine castration. The reasons for these associations were not determined with this study. Improved ability to recognize pain behaviors in horses, however, and increased focus on pain management in veterinary education may explain the association with year of graduation. It is not surprising that veterinarians who consider animals to be at increased pain after castration would be more likely to recommend analgesia. The absence of a gender effect in the final multivariable model is interesting because previous studies have shown significant differences in rating of pain severity after castration based on respondent's gender. (Sellon, Sanz, Kopper, et al., 2022) It is unclear why gender was not a variable retained in the final model when it is associated with higher post-procedural pain scores are associated with increased likelihood of recommending post-castration analgesia.

There were 10 respondents who provided no pre- or post-castration NSAIDs and did not use lidocaine at the time of castration. Three of these respondents rated the level of pain experienced by horses after castration as 7 or 8, yet they provided no analgesia beyond what was required for short-term anesthesia for a recumbent castration. These 3 respondents all indicated that they used butorphanol, xylazine, and ketamine at the time of castration. They were all in private clinical practice comprised of 76 - 100% horses and 2 of 3 graduated between 1980 and 1989. Butorphanol and xylazine are estimated to provide analgesia for a maximum of 3

to 4 hours or 60 minutes, respectively, after intravenous administration. (Sanchez and Robertson, 2014) It is impossible to know exactly how long a horse may be painful after routine castration, but studies have reported behavioral evidence of pain for more than 8 hours (Dalla Costa et al., 2014; Lemonnier et al., 2022; Love et al., 2013), suggesting that relying only on drugs administered at the time of surgery may be inadequate for pain control.

Rating of the severity of pain experienced by young horses after routine castration has been reported in several previous studies. In a 2002 study of veterinarians in the United Kingdom (UK), 70% of respondents considered pain associated with castration to be "low". (Price et al., 2002) Using numerical rating scales in which 0 or 1 is no pain at all and 10 is the worst possible pain, several studies report median pain ratings after castration between 4 and 7 with a range from 0 or 1 to 10. (Dujardin and van Loon, 2011; Lorena et al., 2013; Sellon, Sanz, Kopper, et al., 2022; Waran et al., 2010) This consistently broad range of scores across multiple studies in multiple countries suggest a continuing lack of consensus among veterinarians regarding the degree of pain experienced by horses after castration.

There are little previous data regarding pain management practices of equine veterinarians in the US associated with routine castrations of young horses. A 2005 study indicated that only 36.9% of equine veterinarians in the UK routinely provided analgesia to horses after castration. (Price et al., 2005) In a 2018 study of equine veterinarians in Australia, 43% of respondents gave one or more NSAID doses after surgery. (Owens et al., 2018) In the current report nearly 75% of respondents (107/146, 73.3%) routinely recommended analgesia after equine castration. It is difficult to compare results from studies that span 2 decades and 3 continents and that used very different survey instruments, but cumulatively these reports suggest that NSAID administration during the perioperative castration period may be more common now as compared to 20 years previously. This possibility is supported by current results demonstrating the association of post-castration analgesia recommendations by US veterinarians with recent year of graduation.

This was a cross-sectional survey study which used a convenience sampling strategy with electronic distribution of survey invitations and associated potential for sampling and respondent bias. In addition, the sample size was relatively small as compared to the total population of equine veterinarians in the US. The results, therefore, should be interpreted with some caution.

These data confirm the lack of consensus regarding the degree of pain experienced by horses after routine castration and a lack of consensus on appropriate pain management strategies for these patients. Pain management guidelines for dogs and cats are provided by professional organizations in the US with regular updates. (Gruen et al., 2022) Evidence-based guidelines for equine analysia, including perioperative analgesia for horses undergoing routine castration, were published by the British Equine Veterinary Association (BEVA) in 2020. (Bowen et al., 2020) These guidelines included recommendations for administration of pre-castration NSAIDs with a high level of overall certainty and administration of post-operative NSAIDs for at least 3 days after surgery with a moderate level of overall certainty. No analgesia guidelines for horses have been provided by professional veterinary organizations in the US. The American Association of Equine Practitioners (AAEP) provides practice guidelines related to many other facets of equine practice including biosecurity, vaccination, drug compounding, euthanasia, and parasite control. Given the lack of consensus within the profession related to perioperative analgesia for horses undergoing routine castration, the frequency with which castrations are performed, the welfare concerns associated with inadequate perioperative analgesia, and the analgesia guidelines available for other species in the US and for horses in other countries, it is recommended that the AAEP develop evidence-based guidelines for this very important area of equine practice.

Table 1. Odds ratios and 95% confidence intervals (CI) of categorical variables and their association with recommendation of postoperative analgesia after routine castration of a healthy yearling colt.

Categorical Variables	Recommend analgesia $(\%)$	Do not recommend analgesia (%		
Academic, government or other practice Private clinical practice	$\begin{array}{c} 19 \ (17.9\%) \\ 87 \ (82 \ 1\%) \end{array}$	4 (10.3%) 35 (89 7%)		

Categorical Variables	Recommend analgesia (%)	Do not recommend analgesia (%		
Multi-veterinarian practice	81 (76.4%)	19 (48.7%)		
Solo practitioner	25~(23.6%)	20(51.3%)		
Credentialed veterinary technician in practice	53 (49.5%)	15(38.4%)		
No credentialed veterinary technician in practice	54 (50.5%)	24(61.5%)		
Veterinarian's practice population is $< 75\%$ horses	22 (20.6%)	7 (17.9%)		
Veterinarian's practice population is $> 75\%$ horses	85 (79.4%)	32 (82.1%)		
Average value of patients $<$ \$10,000	60 (57.1%)	28 (71.8%)		
Average value of patients $>$ \$10,000	45 (42.9%)	11 (28.2%)		
Respondent does not own horses	29(27.1%)	14 (35.9%)		
Respondent does own horses	78 (72.9%)	25(64.1%)		
Female	78 (73.6%)	21 (53.8%)		
Male	28 (26.4%)	18 (46.2%)		
Veterinary degree completed after 2000	65(61.3%)	12(31.6%)		
Veterinary degree completed before 2000	41 (38.7%)	26(68.4%)		
Board-certified in a recognized veterinary specialty	30 (30.9%)	7 (19.4%)		
Not board-certified in a veterinary specialty	67 (69.1%)	29 (80.6%)		
Perform < 10 castrations/year	71 (66.4%)	26(66.7%)		
Perform > 10 castrations/year	36 (33.6%)	13(33.3%)		
Prefer standing castrations	13 (12.1%)	6 (15.4%)		
Prefer recumbent castrations	94 (98.9%)	33 (84.6%)		

* Indicates variables included in backward stepwise regression analysis.

Table 2. Final multivariable logistic regression model for veterinarians who recommend analgesia after castration of a healthy yearling colt. CI = confidence interval.

Variable	Coefficient	Standard Error	Wald Statistic	P value	Odds Ratio	95% CI
Practice type	0.8	0.5	2.8	0.1	1	0.9 - 5.3
Graduation year	1	0.5	5	0.03	2.8	1.1 - 6.7
Pain severity score	-0.4	0.1	10.1	0.002	0.7	0.5 - 0.9

Figure Legends

Figure 1. Flow chart illustrating inclusion criteria for final data set.

Figure 2. Number of respondents recommending administration of nonsteroidal anti-inflammatory drugs (NSAIDs) for the specified number of days after routine castration of a healthy yearling colt.

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Figure 1.



Figure 2.