

Prevalence and associated factors of injury in bovine practitioners in the United States and Canada

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Abstract

A cross-sectional online survey was administered to American Association of Bovine Practitioner members to determine the prevalence of injuries to veterinarians due to performing rectal palpation or other common work-related injuries among bovine practitioners. Basic demographic information was collected on veterinarians related to their time in practice, gender, physical attributes that may be risk factors for injury, characteristics of their practices, and geographic information. From the surveys, 1158 responses were analyzed. Seventy-seven percent of respondents experienced pain while rectally palpating cattle, of which 42% reported severe pain. Multiple locations were reported as the source of pain (80% arm/elbow, 70% shoulder). Fifty-two percent reported that pain limited performance slightly, and 7% moderately or severely. On average, pain started 12 years after beginning practice. Years in practice, herd size, and changing palpating arm due to pain were associated with experiencing pain. Surgical treatment of the practitioner was positively correlated with increasing age, a higher average number of beef herds visited daily, increased average number of palpations daily, the use of a stall for palpation, use of analgesia, and predominantly using the left hand. Pain for practitioners during bovine rectal palpation is a common occurrence. Veterinary students as well as practitioners should be educated about ways to mitigate these potential occupational hazards, and further research should be conducted on how practices can be modified to reduce these outcomes.

Key words: palpation, injury, bovine, occupational injury, veterinarian

Résumé

Un sondage transversal en ligne a été mené auprès des membres de l'*American Association of Bovine Practitioners* dans le but de déterminer la prévalence de blessures

subites par les vétérinaires lors de la palpation rectale ainsi que d'autres blessures reliées au travail chez les praticiens bovins. On a recueilli de l'information démographique auprès des vétérinaires en lien avec les années en pratique, le genre, les attributs physiques qui pourraient être des facteurs de risque de blessures, les caractéristiques de la pratique et la localisation géographique. On a analysé les réponses de 1158 répondants au sondage. De la douleur lors de la palpation rectale des bovins a été ressentie par 77% des répondants et 42% ont rapporté de la forte douleur. La source de douleur était localisée à différents endroits (80% pour le bras/coude, 70% pour l'épaule). Cette douleur limitait un peu la performance chez 52% des répondants et modérément ou beaucoup chez 7% des répondants. La douleur en moyenne commençait 12 ans après le début de la pratique. Le fait de ressentir de la douleur était associé avec les années en pratique, la taille du troupeau et le changement de bras causé par la douleur lors de la palpation. Le traitement chirurgical du praticien était associé à l'âge, à un plus grand nombre en moyenne de troupeaux de boucherie visités par jour, à un plus grand nombre de palpations par jour, à l'utilisation d'un enclos pour la palpation, à l'utilisation d'un analgésique et à l'utilisation prédominante de la main gauche. La douleur chez les praticiens est fréquente lors de la palpation rectale. Les étudiants vétérinaires et les praticiens devraient apprendre comment éviter ces risques professionnels. Il devrait aussi y avoir plus de recherche pour identifier les changements de pratiques nécessaires pour réduire ces risques.

Introduction

Two case reports by human physicians and veterinarians have documented shoulder, neck, and other joint injuries in large animal practitioners, and especially those working with cattle.^{1,8} These physicians have speculated that repetitive bovine rectal palpation maneuvers may be the cause of the joint injuries in veterinarians. One survey of bovine practitioners (BP) found that veterinarians palpated, on average, 136 cows

per day with a range up to 1,800 cows per day.⁵ The repetitive motion of doing multiple rectal examinations over short periods of time appears to lead to cumulative musculoskeletal and nervous disorders or palpations can result in acute injuries in veterinarians. However, few studies have attempted to determine the prevalence of these occurrences in BP.

In 1996, a survey was mailed to all members of the American Association of Bovine Practitioners (AABP) to try to determine the prevalence of bovine rectal palpation-associated cumulative trauma disorders (CTD) and acute traumatic injuries affecting BP.⁵ The author found that 71% of responding BP reported CTD which started on average 12 years after graduation, and 31% reported acute traumatic injuries associated with performing rectal palpation in cattle. However, the response rate by veterinarian members to this mailed survey was less than optimal (about 9%; 434 of 4952 members). The respondents tended to be in practice significantly longer than the general membership (19.5 years vs 14.2 years), so they may not have been representative of all bovine practitioners. It is also possible that persons suffering an injury may be more likely to respond to a survey about injuries than those who have not been injured.⁵

Furthermore, since 1996, bovine practice has gone through several modifications in North America, especially the introduction of ultrasonography as a method for pregnancy detection. In addition, many on-farm skilled employees perform various activities which traditionally were considered to only be performed by veterinarians, from palpation through assisting with dystocia, and even Cesarean sections. The impact of these changes, however, on veterinarian injuries and general health is unknown.

Web-based surveys are gaining in popularity for several reasons. First, they tend to have lower cost as there are no costs associated with mailing out surveys by postal mail nor for reminder cards to follow up with non-respondents. Cost is also lower and efficiency improved as data entry is automatic so there is less room for error when transcribing results into a database by hand. A second advantage is time, both for how long it takes participants to fill out a survey to the time it takes to get results. Web-based surveys can have higher response rates because of access to a wider geographic audience, although there have been reports of an age bias or changes in socio-demographic populations reached. They tend to feel more anonymous as no return address is necessary, making some people feel more comfortable with participating.¹⁵

The objective of this survey was to determine the prevalence and risk factors for occupational injuries, both associated with bovine rectal palpation as well as others, in BP in the United States and Canada.

Materials and Methods

Study Design

A cross-sectional study was performed utilizing an online survey. The survey was drafted by the authors

with input from the Board of Directors of the AABP. SurveyMonkey.com[®] was used, which is an on-line secure survey designer that allows easy creation of questionnaires, collects survey responses, and stores them in a secure database. Using this system, all responses are kept confidential. There were 132 questions, all of them closed, with either continuous or categorical responses. Following approval by Purdue University Institutional Review Board, a link to the website was sent to members of the AABP by an association-specific listserv in 2 mass e-mail messages: 1 at the beginning of the study and a second e-mail 1 month later to encourage participation. A link to the survey was included in a monthly newsletter as a reminder to those members who received the e-mail, those members who did not have an e-mail account, or those having an incorrect e-mail address listed with the association. The survey was available to participants for a 2-month time period (end of November 2009 to the end of January 2010).

Survey Content and Settings

Basic demographic information about surveyed veterinary respondents related to their time in practice, gender, height, weight, age, recreational activities and frequency of participation, characteristics of their practices (number of herds served, busiest months, percentage of practice for beef and/or dairy), and basic location information was collected. Identifying information such as name, telephone number or address was not collected. Additional questions were collected on their normal palpation practices, history of palpation-related injuries, and other injuries not related to rectal palpation of cattle. Multiple internet protocol (IP) address access to the survey was allowed so that multiple veterinarians at 1 practice could participate on the same computer if shared. Duplicate entries were manually removed when more than 1 survey was completed from 1 IP address where answers were identical but only a partial survey was completed in 1 entry. The partial surveys were removed from analysis. Additionally, surveys from participants in countries outside the US or Canada were excluded from analysis.

Statistical Analysis

All statistical analyses were performed using commercial statistical packages.^{a,b} Initially, data were imported from the online survey to an Excel spreadsheet for processing and coding. Continuous variables such as age, weight, height, and years in practice were plotted to assess normality in their distribution. Descriptive statistics were performed for important variables (mean, standard deviation, range). A Student t-test was used to compare continuous variables. Univariate analysis was used to assess the association between individual variables and several outcomes of interest (e.g., pain during palpation and shoulder surgery due to prolonged pain). Variables that had a $P < 0.1$ on the univariate analysis were included in the multivariate analysis using logistic regression. Multivariate analysis used backward selection and

tests for interactions were performed. Correlation between variables included in the model was assessed. For the final model, confounders were assessed if the point estimate was changed by at least 10% from its value prior to the potential confounder inclusion. The Akaike Information Criterion value was used to determine goodness-of-fit.

Time-to-Event

Kaplan-Meier curves were created to compare time from starting practice to pain due to palpation between genders and between working in a practice that is comprised of less than 50% or greater than 50% bovine patient caseload, as well as to compare between when a practice consisted of greater than 50% dairy vs beef. Similarly, curves were created to compare time from starting practice to surgery due to pain during bovine rectal palpation among practitioners who reported pain. A log-rank test was used to assess statistical significance ($P \leq 0.05$).

Spatial Analysis

In order to assess spatial clusters of number of cases for several variables such as pain on palpation and surgery due to pain on palpation, SaTScan^c was used. We chose a Bernoulli (case-control) distribution because the total number of bovine practitioners in the country was not available. The software calculated the expected number of cases (e.g., pain during palpation or surgery due to pain) inside a scanning space window of varying size under a Bernoulli (case-control) distribution. Maximum scanning window size was limited to the default of 50% of the area. The case distribution and *P*-values were obtained by Monte-Carlo simulation and ranked by comparing maximum likelihoods from 999 replications.

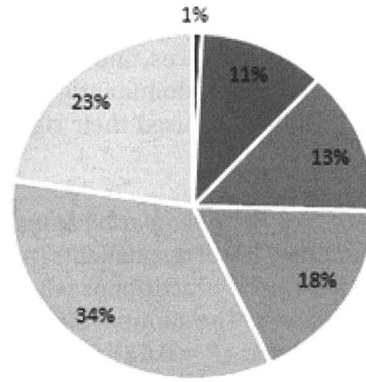
Results

After removing duplicate entries, a total of 1240 surveys were completed from participants in 14 countries out of 5000 AABP members (a 25% response rate). Eighty-two surveys were excluded as they were completed by participants outside the US and Canada. Included in the analysis were 1065 (92%) surveys from US practitioners from 47 states and 93 (8%) from practitioners in Canada. The number of participants from each state was highly correlated with the number of AABP members in each state (0.97). Of all participants, 77.6% were males. The average age of participating bovine practitioners was 47 years (median=50, range 23 to 75) where approximately 62% were over 47 years of age. The average number of years in practice for the survey participants was 20.6 years; the average number of years in practice was significantly ($P < 0.05$) different between males (23.6) and females (10.5). Of all participants, 72% were in practice more than 10 years and, of these, 52% were in practice over 20 years. Approximately 25% of respondents practiced less than 50% of their time in bovine medicine and,

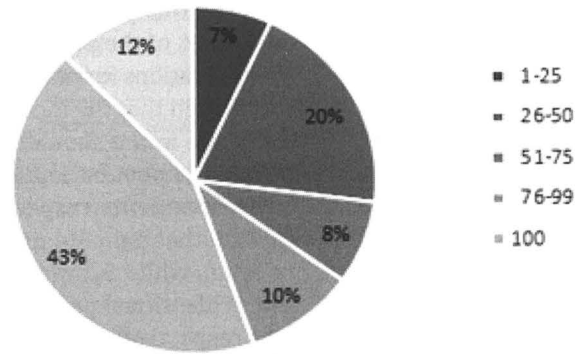
of all respondents, 97% and 93% did at least some beef and dairy practice, respectively (Figure 1).

Of 1158 respondents, 51% did some kind of physical recreational activity which may lead to injuries similar to what might occur with palpation (rock climbing, swimming, etc). The average number of cows palpated daily for dairy

a. % Bovine Practice



b. % Dairy Practice



c. % Beef Practice

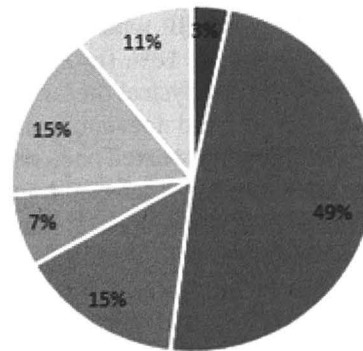


Figure 1. Percent of veterinary practice consisting of bovine (a), dairy (b), and beef (c) for American Association of Bovine Practitioners from the US and Canada participating in an online survey, 2010.

and beef was 86 and 80 head, respectively. On average, bovine practitioners responding to this survey performed 280 transrectal ultrasound exams and 7.3 uterine lavages monthly. Survey respondents indicated that they used palpation chutes (58%), tie stalls (43%) or head gates (67%) when performing rectal palpations in cattle. Twenty percent and 5% of veterinary respondents indicated that they always or often used palpation rails or stools, respectively. During the course of their career, 91% of respondents used some kind of lubrication for bovine rectal palpation where 48% used a commercial lubricant, 17% used feces or water, 25% used a combination of commercial lube and feces, and 5% used all 3 types of lubrication. Practitioners predominantly palpated with their left arm (66%), while 21% used their right arm and 13% used both arms.

Practitioner Pain During Bovine Rectal Palpation Maneuver

Seventy-seven percent (n=729) of respondents (n=949) experienced pain as defined by the practitioner when performing bovine rectal palpation. The number of years in practice was positively correlated ($P = 0.02$) with BP that reported pain when rectally palpating cattle. On average, pain during palpation was first noticed by the BP 12 years (range 0.5 to 40) after the commencement of bovine medicine practice. This value was significantly ($P < 0.05$) different between males (18 years) and females (9 years). Of all practitioners who reported pain, 93% (n=678) felt this pain often or always. Severe pain was reported in 42% of the practitioners (n=306). Most BP reported multiple locations for pain. Eighty percent of survey respondents indicated that the location of pain was in the arm/elbow area, 70% in the shoulder, and 32% in the wrist. Neck, lower back, and upper back pain was reported in 23, 17, and 11% of BP respondents, respectively. Of all BP respondents, 41% reported that pain did not limit their professional performance at all, while 52 and 7% reported that the pain limited their professional performance slightly and moderately/severely, respectively.

Pain Requiring Non-Operative Treatments

Of the 729 who reported pain, 28% used some kind of analgesia/NSAID on a regular basis before bovine rectal palpation (compared to 5% among BP who reported no pain), and 35% rarely used it. About 18% (n=127) of BP who reported pain actually received physical therapy due to pain compared to 5.4% (n=12) who did not report pain due to bovine rectal palpation. Of BP who reported pain, physical therapy received involved the shoulder (52%), elbow/arm (22%), neck (15%), back (15%), and hand (12%). The most common diagnoses associated with pain during palpation were 22% arthritis (elbow, hand, or back), 11% carpal tunnel, and 11% were diagnosed with tennis/golfer elbow. Of the 729 reported pain cases, 16% used chiropractic therapy (compared to 2.2% for BP who did not report pain) to treat their pain for a duration that varied between a single session to 100 weeks. Of these, 59% involved some part of the

back, 38% the neck, 19% shoulder, 6% arm/elbow, and 3% involved the hand. Four percent and 2% of the 729 BP who reported pain used acupuncture or an occupational therapist, respectively. About 3% used nerve blocking for pain in the elbow, shoulder, back, neck, or wrist. Eleven percent of respondents reported changing their dominant palpating arm due to injury.

Potential Risk Factors for Experiencing Pain During Bovine Rectal Palpation Maneuvers

The average number of dairy farms visited daily (2.9 vs 3.3) and weekly (12.5 vs 11.7) did not differ significantly between BP who reported pain and those who reported no pain during palpation, respectively. Similarly, the average number of beef farms visited daily (1.6 vs 1.5) and weekly (4.9 vs 4.5) did not differ significantly between BP who reported pain and those who reported no pain during palpation. However, respondents did not have to specify if these were all visits or just visits for bovine rectal palpation. On univariate analysis, pain on bovine rectal palpation was positively associated with average dairy and beef herd size in the veterinary practice, average number of beef cows palpated daily, and average number of dairy cows palpated daily. Additionally, use of analgesia before bovine rectal palpation was also positively associated with pain during palpation, and with changing palpating arm due to pain. Participation in recreational activity was not associated with pain during palpation. On a multivariate analysis, years in practice, herd size and changing palpating arm due to pain were positively associated with pain during palpation (Table 1).

Using Kaplan-Meier time-to-event curves, females' time to pain due to bovine rectal palpation was significantly shorter than for male practitioners from starting practice career ($P < 0.01$, Figure 2). After approximately 15 years of practice, BP with >50% of their caseload being bovine were significantly more likely to feel pain due to palpation than BP with <50% of their caseload being bovine ($P = 0.03$, Figure 3). No significant difference was found between the time-to-event curves of dairy and beef practitioners.

Pain Leading to Surgery

Of 729 who reported pain, 82 (11%) required surgery due to a palpation-related injury, compared to 4% among the 220 BPs who did not report pain. Of the 82, 94% were male,

Table 1. Multivariate analysis for potential risk factors for pain during rectal palpation among US and Canada bovine practitioners based on online survey (2010).

Variable	Estimate	OR (CI 95-OR)
Years in practice (continuous)	-0.014 (0.007)	0.986 (0.973-0.999)
Average herd size in practice (continuous)	0.005	1.003 (1.001-1.006)
Changing palpating arm due to pain	0.0018	2.163 (1.140-4.104)

and average age when surgery occurred was 49. On average, surgery took place 27 years after starting bovine practice, and about 9 years after onset of pain. Of the 82 veterinarians who required surgery for a palpation-related injury, 44% involved the shoulder (rotator cuff repair), 19% the hand/wrist, 15% the arm/elbow, 14% the knee/hip, and 5% the lower back. Median and average number of working days missed due to surgery was 21 and 49 (range 1 to 200), respectively. Forty percent of the 82 BPs reported that surgery resulted in no

limitations of their post-operative work. Surgery was reported to slightly limit their post-surgery veterinary performance in 35% of the 82, moderately in 16%, and severely in 8%. By multivariate analysis, surgery due to pain from palpating was associated with increasing age as a continuous variable, higher number of beef herds visited daily, increasing number of palpations daily, the use of a stall for palpation (always/often vs never/rarely), use of analgesia, and predominantly using the left hand (Table 2). Another 28% of respondents

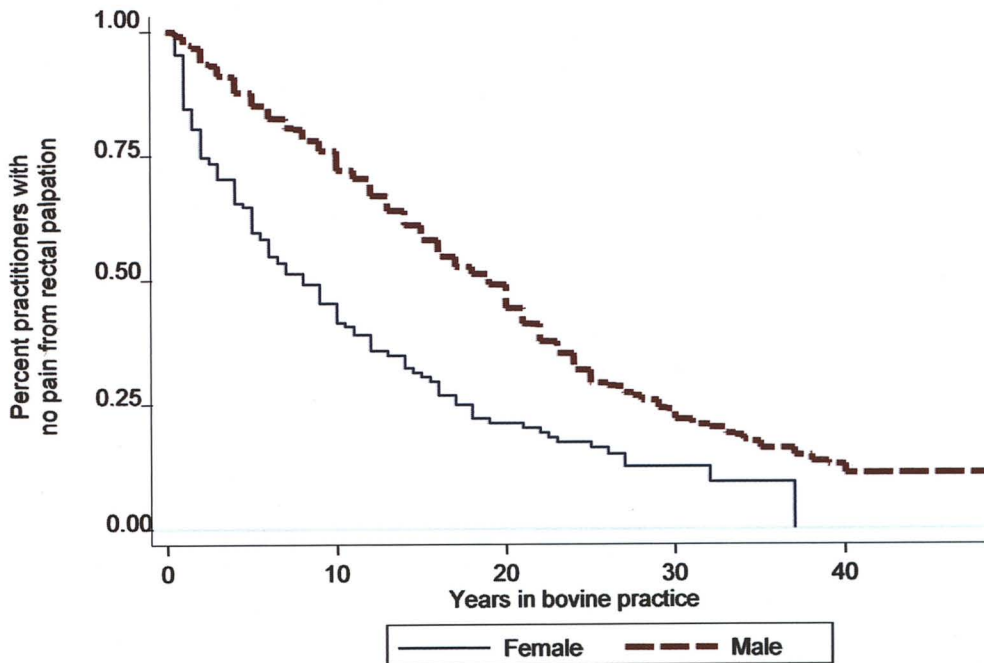


Figure 2. Kaplan–Meier time-to-event curves for time to pain due to rectal palpation among male and female bovine practitioners in the US and Canada participating in an online survey (2010).

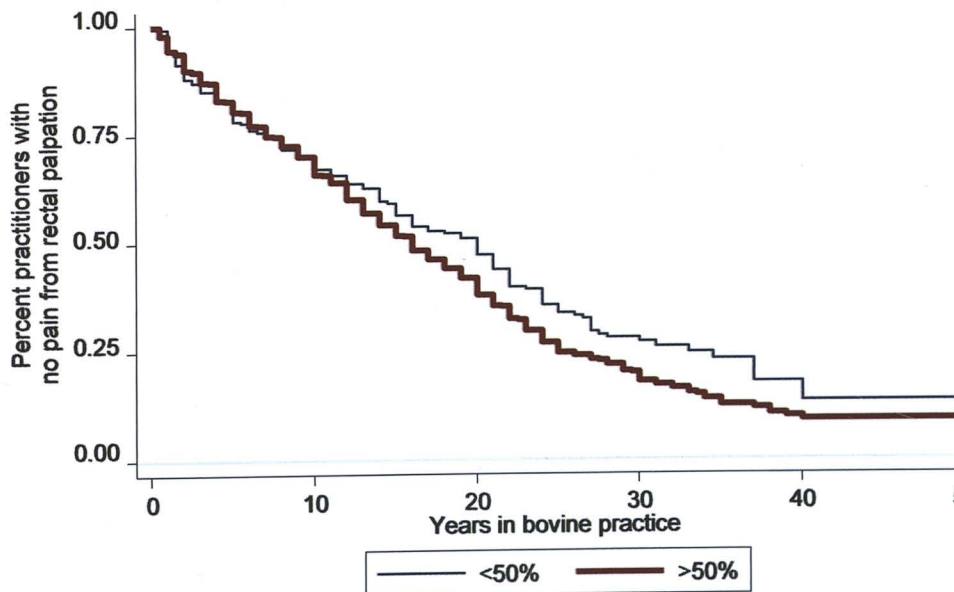


Figure 3. Kaplan–Meier time-to-event curves for time to pain due to rectal palpation among bovine practitioners with greater than or less than 50% bovine practice in the US and Canada participating in an online survey (2010).

reported requiring a surgery that was work related, but was not due to the performance of palpation maneuvers. Of these, 30% were in the hand (including wrist and finger), 21% in the knee, 11% in the back and neck, and 10% in the shoulder and arm. Of these, 76 (32%) and 12 (5%) reported that this surgery moderately or severely limited their subsequent working performance, respectively. Kaplan-Meier survival analysis indicated that BP with greater than 50% of time in dairy practice were significantly more likely to have surgery than BP with less than 50% of time in dairy practice (Figure 4; $P < 0.001$).

Spatial Clustering

No spatial clustering was detected for pain during palpation or surgery due to this pain.

Calf Extraction

Of 900 respondents, 696 (77%), 187 (21%), and 16 (2%) always, often, or rarely/never use chains while extracting calves, respectively, and 540 (60%), 160 (18%), and 200 (22%) use calf retractors, respectively. About 93% of BP reported doing calf extractions in the previous year. The number of calf extractions varied from 1 to over 360, where

Table 2. Multivariate analysis for potential risk factors for surgery among US and Canada bovine practitioners due to pain during rectal palpation based on online survey (2010).

Characteristic	Adjusted β (SE)	P	OR (95% CI)
Age	0.111 (0.041)	0.007	1.12 (1.03-1.21)
Years of practice	-0.340 (0.162)	0.036	0.71 (0.52-0.98)
Years of bovine practice	0.312 (0.154)	0.043	1.37 (1.01-1.85)
Average no. beef herds daily	0.264 (0.127)	0.036	1.31 (1.02-1.68)
Average no. palpations daily	0.006 (0.001)	<0.001	1.01 (1.00-1.01)
Palpation stall used			
Never/rarely	Reference		1.00
Always/often	0.978 (0.338)	0.004	2.66 (1.37-5.16)
Use analgesia/NSAID before palpation			
Never	Reference		1.00
Rarely	0.872 (0.389)	0.025	2.39 (1.12-5.13)
Regularly	0.921 (0.408)	0.024	2.51 (1.13-5.58)
Predominantly palpate with arm			
Right	Reference		1.00
Left	1.019 (0.409)	0.013	2.8 (1.25-6.25)

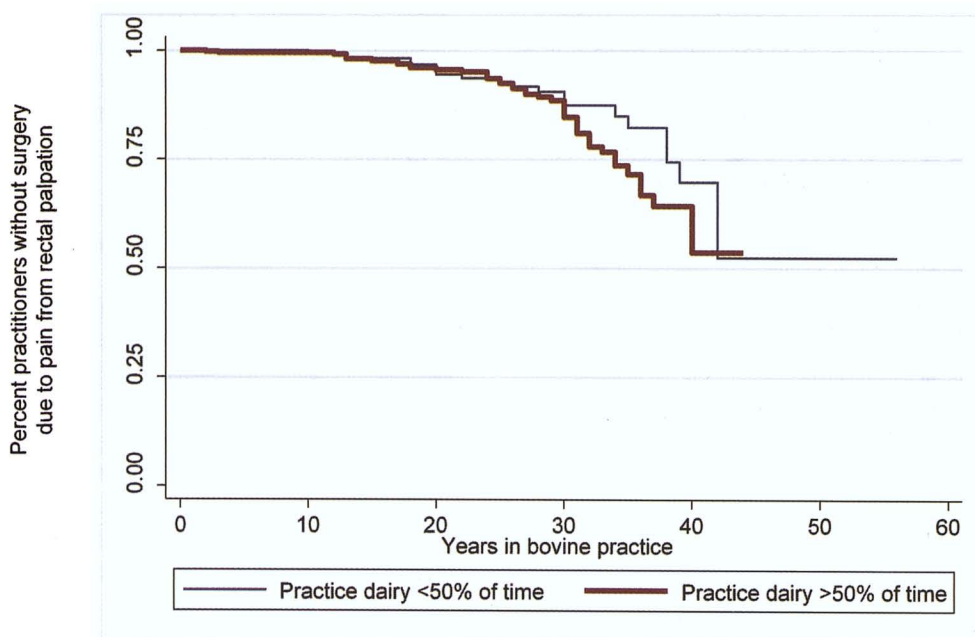


Figure 4. Kaplan–Meier time-to-event curves for time to surgery due to pain during rectal palpation among bovine practitioners with more than and less than 50% time in dairy practice in the US and Canada participating in an online survey (2010).

3 practitioners indicated “too many to count.” Of all respondents with relation to injury from calf extraction, 256 (28%) indicated some injury. Of these 256 veterinarians, 67 (26%) reported bruising, abrasions, skin lacerations and dermatitis. Fifty (20%) reported some back injury, and 11% reported shoulder injury. Fifteen (6%) and 8 (3%) reported injuries due to the calf extractor and kicking, respectively. In univariate analysis, a positive correlation existed between injury as a result of calf extraction and pain during palpation for the same veterinarians. In multivariate logistic regression, age as a continuous variable, gender, practicing beef medicine less than 50%, and years in practice were associated with calf extraction injury. Males were 1.6 (1.04 to 2.43) times less likely to be injured than females. BP who practiced beef medicine more than 50% of their time were 1.28 (CI 1.01 to 1.14) times less likely to be injured than BP who practiced a lesser percentage. For each year in practice, the risk to have an injury as a result of calf extraction increases between 1 and 14%.

Hoof Trimming

Of 80 respondents, 51 (64%) perform hoof trimming occasionally, 16 (20%) never, and 13 (12%) routinely. Only 9% (7) reported injury due to hoof trimming; of these 70% perform hoof trimming routinely. Injured body part was the hand in all cases, and in 1 case the back was also involved. No missed working days were reported due to hoof trimming.

Other Injuries

The online questionnaire addressed several other practice-related injuries including being squeezed between 2 cows, kicked by a cow, injured by a bull, injured from lifting heavy objects, car accidents in a work-related vehicle, and being stuck with a needle. These injuries are briefly described in Table 3. In the multivariate analysis for different injuries (Table 4) several variables were repeatedly associated with these injuries. They include: average number of dairy herds visited per day, average number of cows palpated daily, years in practice as well as age as a continuous variable.

Discussion

This is the first study to comprehensively catalog common injuries and their risk factors among bovine practitioners in North America. A total of 1240 surveys were eligible for analysis from 14 countries. We decided, however, to restrict the analysis to only 1158 surveys completed by AABP members from the US and Canada in order to decrease the variability among the participants as much as possible. A previous study among AABP bovine practitioners included only 452 participants.⁵ According to the US Bureau of Labor Statistics, musculoskeletal disorders comprised 28% of all reportable occupational diseases in 2009 across all professions, and required an average of 10 days off work whereas shoulder injuries required 21 days off.⁴ The survey results describe a variety of preventable injuries that any bovine practitioner could experience. In this study, however, we focused predominantly on musculoskeletal injuries of BP as a result of rectal palpation in cattle. The multivariate analysis aimed at identifying risk factors for these injuries, which may serve useful in prevention and education for health providers and bovine practitioners. Similar to our study, Cattell found that the average respondent age was 46.3 and average years in practice was 19.5.⁵ This is a possible indication that the general demography of AABP members and respondents has not changed much in the last decade. The prevalence of pain while palpating (77%) is also similar to the CTD reported by Cattell, who reported 71%.⁵ However, those reporting pain in Cattell's study did not necessarily experience pain specifically due to bovine rectal palpation maneuvers. The incidence of practitioners requiring orthopedic surgery in our study was about 9% among all respondents, which is significantly lower than what was reported by Cattell (23%).⁵ Also, it is not clear that a work-related injury was necessarily the cause of the CTDs in Cattell's study. Our results show that, despite the fact that over a half of the survey participants participated in some kind of recreational activity which may contribute to musculoskeletal injuries, no association was found with pain while palpating, which is in accord with Cattell.⁵ In stud-

Table 3. Summary of frequencies of other injuries reported in online survey by bovine practitioners from US and Canada (2010); total 918 respondents.

Injury	Frequency (%)	Required medical attention (% of injuries)	Missed working days (%)	Limit working performance (%)
Squeezed between 2 cows last 6 months	582 (63.4)	17 (3)	4 (0.7)	17 (3)
Kicked by cow, last 6 mo	709 (77)	70 (10)	9 (1.3)	34 (5)
Ever injured by a bull	223 (24)	68 (30)	49 (22)	*
Injured from lifting heavy object	144 (15.7)	72 (50)	54 (38)	94 (65)
Car accident in work-related vehicle	305 (34.4)	72 (24) [†]	35(12)	16 (6)
Needlestick in the last year	445 (48.6)	11 (2.5)	0 (0)	*
Injured while delivering calf, ever	256 (28)			
Other work related injury, last 5 years	222 (24)	*	217 (98)	111 (50)

*Data not available

[†]32% of these (8% of all car accidents) required hospitalization (range 1 to 190 d, median 2 d)

Table 4. Multivariate analysis for different injuries among bovine practitioners responding to an online survey (2010).

Characteristic	Adjusted β (SE)	P	OR (95% CI)
Kicked by cow last 6 months			
Average number dairy herds/day	0.2129 (0.055)	<0.001	1.24 (1.11-1.38)
Number of palpations/day	0.0032 (0.001)	0.011	1.00 (1.00-1.01)
Injury from bull ever			
Years in practice	0.0261 (0.009)	0.002	1.03 (1.01-1.04)
Average no. dairy herds daily	-0.1601 (0.055)	0.004	0.85 (0.76-0.95)
Average no. beef herds daily	0.3277 (0.090)	<0.001	1.39 (1.16-1.66)
Vaccine stick in last year			
Age (continuous)	-0.0273 (0.006)	<0.001	0.97 (0.96-0.99)
Practice dairy med>50% of time	-0.2291 (0.054)	<0.001	0.80 (0.72-0.89)
Average no. dairy palpations daily	0.0025 (0.001)	0.010	1.00 (1.00-1.00)
Injury due to lifting heavy object			
Years in practice	0.0251 (0.008)	0.001	1.03 (1.01-1.04)
Work vehicle accident			
Age (continuous)	0.0505 (0.007)	<0.001	1.05 (1.04-1.07)
Practicing dairy medicine >50%	0.1544 (0.051)	0.002	1.17 (1.06-1.29)
Injury from calf extraction			
Age (continuous)	-0.0639 (0.030)	0.037	0.94 (0.88-1.00)
Sex (male)	-0.4669 (0.219)	0.033	0.63 (0.41-0.96)
Practicing beef medicine >50%	-0.1305 (0.059)	0.027	0.88 (0.78-0.99)
Years in practice	0.0734 (0.030)	0.015	1.08 (1.01-1.14)

ies of other professions, hobbies were not found to be a risk factor for CTDs.^{11,12} In contrast to Cattell, our study found no association between using one's dominant arm and pain on palpation; however, bovine rectal palpation with the left arm was positively associated with the need for surgery.⁵

The univariate analysis results for pain during bovine rectal palpation (years in practice, average number of herds visited daily, and average number of cows palpated daily) fit with the definition of CTD (i.e., repetitive motions that cause musculoskeletal and nervous system damage). Berry et al found in a survey conducted in 1997 among 1353 veterinarians in California that bovine rectal palpation and large animal practice were risk factors for CTDs.² This risk was especially high among women who were working full-time and doing bovine rectal palpation. In that study, 39% of BP reported that CTD originated from bovine rectal palpation. In the present study, however, gender was neither associated with pain on palpation nor with surgery due to bovine rectal palpation. Nevertheless, the time-to-event curves indicate that female practitioners reported pain due to bovine rectal palpation sooner in practice than males. Further, time-to-event curves indicated a long-term impact of working in a practice comprised of greater than 50% bovine caseload. However, this impact on pain was not significantly different between dairy and beef practitioners who practiced more than half time. Berry et al reported that large animal veterinarians were more likely to report a CTD than other veterinarians in active practice, and the CTDs were more often in shoulders, forearms, elbows, hands and knees than other veterinarians.² Ailsby reported that bovine practitioners that

perform bovine rectal palpation on more than 250 cows per week had chronic arm, shoulder, and neck problems.¹ Similarly, Australian and Dutch surveys also indicated that large animal veterinarians complained mainly about upper limb and wrist pain.^{7,13} These reports coincide with our results where 80% of BP located their pain in the arm/elbow area, 70% in the shoulder, and 32% in the wrist. Nevertheless, in contrast to Berry et al, who reported that only 13% of large animal practitioners had restricted activity or were unable to work, this proportion was higher in our study.¹⁰ Despite injuries reported amongst veterinarians, Browning reported that farm workers in Kentucky are twice as likely to be injured while working with cattle without the presence of a veterinarian than with one.³

In the present study, we tried to assess spatial clustering of pain due to palpation and surgery because we hypothesized that these 2 factors would follow the geographical distribution of large cattle herds (both dairy and beef) in the western part of the US and Canada where palpation of 250 cows/day is plausible.^{1,2} This association was, however, not significant, probably because the number of participants from each state is highly correlated (0.89) with the number of dairy herds rather than the average herd size.

In our study, about one-third of respondents reported experiencing an injury of some kind during calf extraction. While this task does not exactly fit in the CTD definition, the circumstance in which it is performed exposes the veterinarian to potential severe injuries. Calf extraction during dystocia often requires manipulating the calf position while both hands, wrists, and arms are extended into the cow's

uterus and are subjected to the pressure of the birth canal. Whether the animal is standing or recumbent, the strain on the upper limbs and neck is significant. Additionally, any unexpected movement by the dam, particularly if it falls into recumbency, can result in a severe injury to the wrist, elbow, arm, or even shoulder, as indicated by our results. Berry et al also reported that calving manipulation was mentioned by BP as a cause of CTDs.²

A study in Canada found that 26% of veterinarians reported exposure to vaccines in the last 5 years due to accidental needlesticks.⁶ Our study found the proportion of all needlestick injuries (including vaccines) among bovine practitioners was almost 49%. This difference in proportions between the Canadian study and the present study could be due to differences in the population surveyed (all veterinarians vs bovine practitioners) or the fact that we included reporting of all needlestick injuries, and not just those associated with vaccines as injection with infective material is also a potential hazard to the practitioner. Weese and Jack reviewed the literature on needlestick injuries in veterinarians and human healthcare workers and reported the occurrence of needlestick injuries in various studies to be from 64 to 87% of veterinarians.¹⁴ In that same study, over 50% of those reporting injuries had been exposed to animal blood, antimicrobials, and vaccines through needlesticks.¹⁴ While needlesticks appear to be a common occurrence, serious consequences are less common; however, they do occur and can result in inflammation, infection, allergic reactions, and miscarriage, depending on the material injected.^{10,14}

Despite the age of our survey data from 2010, the strength of this study is the number of practitioners that responded and the completeness of information catalogued from the survey. Our study suggests that repetitive bovine rectal palpation procedures pose risks to the practitioner over time. We found a positive correlation between the need for surgery and the practitioner's number of years in practice, as well as with increasing practitioner age. However, care must be taken in interpreting these results. Certain types of injuries, such as rotator-cuff tear injuries, rarely occur in younger people, but it is well known that the incidence of rotator-cuff tears increases with advancing age.⁹ In fact, according to this study, the prevalence of partial- or full-thickness tears increases markedly after 50 years of age. It is therefore unclear to us whether the injuries that were reported by the respondents were the result of the palpating maneuvers directly, or whether our results simply reflect what we should expect to see as aging practitioners continue to perform physically-demanding activities. Future studies pursuing cohort or case-control study design will need to address this question. Nevertheless, the association with herd size and number of cows palpated daily suggests a more synergistic effect of bovine rectal palpation on the effect of age. Based on the high percentage of veterinarians who reported pain, we feel that practitioners should be aware that their ability to perform palpation procedures may be compromised over

time. Consideration for modifying one's career or routine practices over the years to account for this is recommended.

Conclusions

This is the first study to comprehensively catalog common injuries and their risk factors among bovine practitioners. Pain experienced while performing bovine rectal palpation procedures is common amongst practitioners. The onset of symptoms occurs on average after 12 years of practice. Women reported experiencing pain at an earlier onset than men. Pain experienced during palpation maneuvers was shown to significantly impact the bovine practitioners' job performance. Surgery that resulted from work-related injury was found to be associated with missed working days and compromised job performance. Other injuries associated with calf extraction, hoof trimming, or being kicked or squeezed by a cow have impacts on BP health and performance, however, to a lesser extent. As this data is now 7 years old, this study provides strong evidence that further evaluation needs to be performed and published in the literature. In the meantime, practitioners should understand that their ability to perform bovine palpation procedures might be compromised over time. Consideration for modifying one's veterinary practice to involve less physically demanding tasks as the practitioner ages is recommended.

Endnotes

^aSAS Institute Inc., 2008, Cary, NC

^bSTATA, 2012, College Station, TX

^cSaTscan, 2009 v8, Information Management Services, Claverton, MD

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