Survey of disbudding practice on Czech dairy farms

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ABSTRACT

Disbudding is a routine practice in many dairy herds due to the effort to decrease the risk of injuries. Although the disbudding practice is regulated, it can vary among farms. The variation may be caused by many factors, such as herd size or type of breed, but also by farmers' perception of pain caused by disbudding. Hence, the aim of this study was to specify the disbudding practice on dairy farms in the Czech Republic and to assess these practices, including the use of pain mitigation medication, by breed, herd size, and sex of the disbudded calves. We analyzed data from 106 Czech dairy farms, which were collected by a trained interviewer at dairy meetings in 2014–2015. The farmers answered questions regarding the farm's basic characteristics, disbudding practice, and his/her attitude to the pain caused by disbudding. To test the influence of breed, herd size, and sex of disbudded calves on different variables, logistic regression models were used. Disbudding was performed in 92.5% of the surveyed farms; 63.3% of dairy calves were disbudded before 4 wk of age, and Czech Fleckvieh calves were 2.8 times more likely to be disbudded before 4 wk of age than Holstein calves. The hot-iron method was the most used method (69.4%). Calves were 4.5 times more likely to be disbudded by hot iron in herds where both heifers and bulls were disbudded than in herds where only heifers were disbudded. Most (>90%) surveyed farms did not use any pre- or post-procedure medication to mitigate the pain caused by disbudding. The disbudding procedure was performed mainly by farm personnel (94.9%), who were trained by a veterinarian or veterinary technician (46.9%) or by other farm personnel (37.8%) or were not trained (15.3%). Two-thirds of farmers observed behavioral changes in calves after disbudding. Most farmers estimated the pain caused by disbudding to be mild

or moderate (20.4 or 45.9%, respectively) and 15.3% of farmers estimated it to be severe. Almost a quarter of interviewed farmers were unable to assess the duration of pain, 39.8% farmers estimated that the pain lasts only several minutes, and 20.4% estimated that the pain lasts up to 6 h. We detected a tendency that farmers of larger herds estimated pain duration to be shorter (odds ratio = 1.2). To improve calves' welfare, training is needed in disbudding practice, focusing on the advantage of pain mitigation.

Key words: calf, disbudding, farm management, welfare

INTRODUCTION

Disbudding involves the destruction of the cells of the horn bud (AVMA, 2014) and is defined as the removal of horns in calves up to 2 mo of age (Cozzi et al., 2015). Although it is not compulsory, it is routine practice in dairy cattle (81% of farms in the European Union; Cozzi et al., 2015) for several reasons: it decreases the risk of injury to humans during manipulation, it minimizes the risk of animals hurting each other (Gottardo et al., 2011; Cozzi et al., 2015), and it helps cattle adapt to contemporary housing facilities (ALCASDE, 2009; Stock et al., 2013).

The disbudding procedure is regulated by European Council Directive 98/58/EC (European Union, 1998) based on the Recommendation Concerning Cattle (Council of Europe Standing Committee, 1988) and by recommended guidelines in English-speaking countries; for example, The Code of Practice in Canada (Agriculture Canada, 1998) and guidelines from AVMA (2014) and AVA (2016). The practice, however, varies among countries (Misch et al., 2007; ALCASDE, 2009).

The most used method of disbudding is the hot-iron method; more than two-thirds of all calves in the European Union (EU; Cozzi et al., 2015), Canada (Vasseur et al., 2010), and the United States (USDA, 2008) are disbudded using this method. Use of caustic paste and mechanical methods of disbudding (scoop/tube) are

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less common, at 16.0 and 3.5%, respectively, in the EU (Cozzi et al., 2015). Disbudding is frequently performed by farm personnel (Gottardo et al., 2011; Cozzi et al., 2015) but, despite the fact that disbudding is a serious procedure, a low level of professional training on correct disbudding technique among farmers has been reported (26.8%; Gottardo et al., 2011).

Regardless of the method, disbudding is a painful and stressful procedure (Petrie et al., 1996; Hudson et al., 2008; Stafford and Mellor, 2011). Cautery disbudding may cause up to third-degree burns (Taschke and Folsch, 1997), caustic paste causes painful alkali burns, and mechanical dehorning is associated with large, bleeding head wounds. Disbudding is also accompanied by physiological stress responses; for example, cortisol release into the blood (Graf and Senn, 1999; Stafford and Mellor, 2005) and increased heart and respiratory rates (Grøndahl-Nielsen et al., 1999; Stewart et al., 2008) and can negatively affect growth (Bates et al., 2015). Behavioral responses, such as flicking, head-jerks, rubbing, changing posture, and decrease in play behavior, can be observed after disbudding, all of which indicate impaired welfare of the calves (Stafford and Mellor, 2005; Vickers et al., 2005). Moreover, after disbudding, the calves show a negative judgement bias (Neave et al., 2013).

Therefore, strategies have been developed to mitigate the negative effects of disbudding. Most of the negative behavioral and physiological responses are reduced when local anesthetics or analgesics are administered (Stafford and Mellor, 2005). Use of this recommended medication, however, is very low: 20% of European farms use some kind of anaesthetic or analgesic (ALCASDE, 2009); in the United States, 12.4% use anesthesia and 1.8% analgesics (Fulwider et al., 2008); and in Canada, 44.7% use anesthesia and no analgesics (Vasseur et al., 2010). Despite scientific evidence, more than 40% of farmers consider the pain that accompanies disbudding

to be moderate and last only few minutes (Hoe and Ruegg, 2006; Gottardo et al., 2011).

Previous research on farms (mean herd size <100 animals) showed that disbudding practices can be influenced by herd size and breed; however, the results are not consistent (Gottardo et al., 2011; Hokkanen et al., 2015). Another variable might be whether the farmer disbuds only heifers or both heifers and bulls, which has not been tested in previous studies. It is obvious that to increase calves' welfare, it is necessary to investigate different disbudding practices and potential for improvement. Therefore, the aim of this study was to evaluate disbudding practices on dairy farms in the Czech Republic and to assess these practices, including the use of pain alleviation medication by breed, herd size, and sex of the disbudded calves.

MATERIALS AND METHODS

Characteristics of Herds and Design of the Study and Questionnaire

Basic characteristics of dairy herds involved in the milk recording system in the Czech Republic are presented in Table 1. Representatives of 117 Czech dairy farms, representing 10.2% of all dairy farms in the Czech Republic were interviewed by a trained interviewer at dairy meetings in 2014 and 2015. We chose interviewing as a feasible alternative to a mailed questionnaire because the response rate is usually low for questionnaires; for example, 45% in Finland (Hokkanen et al., 2015), 67.3% in the United States (Caraviello et al., 2006), and 42.6% in Italy (Gottardo et al., 2011). All evaluated farms were enrolled in the milk recording system. The design of the questionnaire is presented in Table 2.

As some farmers may not want to admit mistakes or problems on their farms, some of the results reported

Table 1. Comparison of numerical characteristics of national farms, studied dairy farms, and studied farms by breed

Item	National ¹	Study farms		
		All farms	Czech Fleckvieh	Holstein
Dairy farms, no.	1,147	106	57	49
Cows, no.	356,594	43,187	20,071	23,116
Herd size, ² no. of cows	311	407.4 ± 232.7	352.1 ± 183.6	471.8 ± 266.9
Milk production, ² kg/cow per year	8,001	8,171.8 ± 1,527.3	6,992.1 ± 659.6	9,544.1 ± 1,010.0
Age at weaning of calves, ² d	NA ³	70.0 ± 16.4	71.4 ± 18.4	68.3 ± 13.8
Age at disbudding of calves, ² d	NA	25.4 ± 17.3	22.6 ± 15.9	28.4 ± 18.3

¹Animals included in Czech milk recording system; data from the Czech-Moravian Breeders' Corporation (Kvapilík et al., 2016).

²Mean values ± SD.

³Not available.

herein, which are based on farmers’ answers, may be subject to a farmer’s bias and thus may not completely reflect reality on farms.

In total, 106 questionnaires, which represent 9.2% of all farms in the Czech Republic, were used for further analysis (11 farms were excluded from the study because 10 farms kept mixed herds of Holstein and Czech Fleckvieh in varying proportions and 1 farm disbudded only bulls). In total, 43,187 cows were considered, 53.5% were Holstein and 46.5% were Czech Fleckvieh (Table 1). The average herd size of studied farms was 407 cows, which is greater than the mean value for the Czech Republic (Table 1). All farms included in this survey used loose housing of calves and no organic farms were included.

Statistical Analysis

One hundred six farms were included in the analysis and were handled anonymously. We calculated the descriptive statistics as mean ± standard deviations for numerical variables and frequency and percentage for categorical variables (Table 3). To test the influence of breed (Czech Fleckvieh vs. Holstein), herd size, and the sex of disbudded calves (heifers and bulls vs. only heifers) on different variables, logistic regression models were used (procedure GENMOD in SAS; version 9.3, SAS Institute Inc., Cary, NC). Binary logistic regression models were used for testing the age of disbudding (up to 4 wk or after 4 wk), methods of disbudding (hot iron/caustic paste), and observed behavioral changes in calves after disbudding [yes (head wagging + head rubbing against the wall + drooping ears + aversion of milk + other behavioral changes)/no (cannot assess + do not observe any changes)]. Multinomial logistic regression models were used to test the painfulness of disbudding [not painful + mild pain; moderate pain; severe pain and the duration of pain (minutes, up to 6 h,

up to 12 h + more than 12 h)]; the categories “cannot assess” for severity and duration were not evaluated. Some variables were combined due to the small number of observations in each category, and some variables could not be tested because of the small number of observations; for example, performance of disbudding on the farm, use of anesthetics pre-disbudding, use of analgesics pre-disbudding, use of analgesics post-disbudding, use of antibiotics post-disbudding, who disbudded the calves, and how the farm personnel were trained. Odds ratios were calculated only for significant results or results that showed a tendency. For numerical variables, the odds ratio was calculated for herd size when increased by 100 cows. All statistics were calculated using SAS software (SAS Institute Inc.).

RESULTS AND DISCUSSION

Prevalence of Disbudding

According to our survey, disbudding was performed on 92.5% of the surveyed farms, which corresponds with ALCASDE (2009), which reported 93% of farms with dehorned cattle in the Czech Republic. Our results are similar to findings in Italy (95.5%; Gottardo et al., 2011), France (96%; Le Cozler et al., 2012), United States (94%; USDA, 2008), and southern Brazil (98%; Hötzel et al., 2014) but slightly higher than average for EU member states (88.8%; Cozzi et al., 2015) or Finland (72%; Hokkanen et al., 2015). This may be influenced by the housing of cows; all our surveyed farms used loose housing systems, which, according to previous studies, have a higher prevalence of dehorning/disbudding than tie-stall farms (Gottardo et al., 2011; Cozzi et al., 2015; Hokkanen et al., 2015). Previous research also showed a positive effect of herd size on prevalence of disbudding, but for a much lower mean herd size than in our sample (407 cows/farm).

Table 2. Design of the questionnaire about farm practice in calf disbudding

Area of management	Criterion (variable)
Dairy farm basic characteristics	Herd size, breed, milk performance, age at weaning, age at disbudding
Disbudding practice on dairy farms	Disbudded before or after d 28, housing of disbudded calves, sex, method of dehorning or disbudding, who is disbudding the calves, how was this person trained, use of anesthetics before disbudding, use of analgesics before or after disbudding, use of disinfection or antibiotics after disbudding
Farmer’s view on disbudding	
What can be observed in calves after disbudding	Head wagging, head rubbing against the wall, drooping ears, aversion of milk, other behavioral changes, cannot assess, don’t observe any changes
Whether the disbudding is painful	Not painful, mild pain, moderate pain, severe pain, cannot assess
How long the pain lasts	Minutes, up to 6 h, up to 12 h, more than 12 h, cannot assess

Table 3. Categorical characteristics of studied dairy farms with disbudding practice

Criterion (variable)	Specification	All herds		Czech Fleckvieh		Holstein	
		No.	%	No.	%	No.	%
Calves reared to weaning	Rearing of both sexes	68	64.2	45	79.0	23	47.0
	Rearing of heifers, sale of bulls	38	35.8	12	21.0	26	53.0
Disbudding of calves	Yes	98	92.5	51	89.5	47	95.9
	No	8	7.5	6	10.5	2	4.1
Age at disbudding	Younger than 28 d, inclusive	62	63.3	38	74.5	24	51.1
	Older than 28 d	36	36.7	13	25.5	23	48.9
Housing of disbudded calves	Individual	77	78.6	38	74.5	39	83.0
	Group	19	19.4	12	25.5	7	14.9
	Individual and group	2	2.0	1	2.0	1	2.1
Category of disbudded calves	Heifers and bulls	62	62.3	36	70.6	26	55.3
	Heifers only	36	36.7	15	29.4	21	44.7
Method of disbudding	Hot iron	68	69.4	35	68.6	33	70.2
	Caustic paste	24	24.5	15	29.4	9	19.2
	Combination of methods	6	6.1	1	2.0	5	10.6
Who disbudded the calves?	Farm personnel	93	94.9	47	92.2	46	97.9
	Veterinarian	3	3.1	2	3.9	1	2.1
	Combination of farm personnel and vet	2	2.0	2	3.9	0	0.0
Who trained the farm personnel who disbudded the calves?	Veterinarian	40	40.8	23	45.1	17	36.2
	Farm personnel	37	37.8	19	37.3	18	38.3
	Combination of farm personnel and vet	6	6.1	4	7.8	2	4.2
	Nobody	15	15.3	5	9.8	10	21.3
Use of anesthetics pre-disbudding?	Yes	6	6.1	3	5.9	3	6.4
	No	92	93.9	48	94.1	44	93.6
Use of analgesics pre-disbudding?	Yes	2	2.0	1	2.0	1	2.1
	No	96	98.0	50	98.0	46	97.9
Use of disinfection post-disbudding?	Yes	57	58.2	30	58.8	27	57.5
	No	41	41.8	21	41.2	20	42.5
Use of analgesics post-disbudding?	Yes	1	1.0	0	0.0	1	2.1
	No	97	99.0	51	100	46	97.9
Use of antibiotics post-disbudding?	Yes	2	2.0	2	3.9	0	0.0
	No	96	98.0	49	96.1	47	100.0

Gottardo et al. (2011) showed the odds ratio to be 7.3 times greater for calves to be dehorned in herds with >60 cows compared with those in smaller herds. Hokkanen et al. (2015) reported 100% probability of calves on farms with >60 cows being dehorned. Gottardo et al. (2011) showed that the likelihood of being dehorned is lower on farms rearing dual-purpose breeds than in those with pure milk breeds (65.1% vs. 88.4%, respectively). However, we could not test these variables because the data set of our surveyed farms was noticeably unbalanced (98 farms performed disbudding and 8 farms did not).

Age at Disbudding

The mean age at disbudding was 3.6 wk (median 20 d; 2.9 wk; Table 1), which is lower than 6.4 wk (median) in Canada (Vasseur et al., 2010) and 4.6 wk (mean) in Italy (Gottardo et al., 2011). The age range when calves were disbudded on surveyed Czech farms, however, was very wide, from 3 to 68 d of age. In our study, 63.3% of calves were disbudded before 4 wk of

age, which is higher than some previous reports: 21% in Canada (Misch et al., 2007) and 17% in southern Brazil (Hötzel et al., 2014), but lower than in Finland, where Hokkanen et al. (2015) reported that 95% of respondents disbudded calves before the age of 4 wk. The main reason that most calves were disbudded before 4 wk of age may be that EU and Czech legislation allows the disbudding of calves without the use of pain-mitigating medication until this age. We found that Czech Fleckvieh calves were 2.8 times more likely than Holstein calves to be disbudded before 4 wk of age ($P = 0.02$; Table 4). This result does not correspond with the findings of a study in Italy, where breed did not affect the age of calves at disbudding (Gottardo et al., 2011). However, our result may be caused by some differences in approach and attitude of calf management between farmers who keep dairy breeds (Holstein) and those who keep dual-purpose breeds (Czech Fleckvieh), as has been shown in a previous study (Staněk et al., 2014). Herd size and sex of disbudded calves did not significantly influence age at disbudding ($P > 0.1$; Table 4).

Method of Disbudding

Of the surveyed farms in the Czech Republic, 69.4% used the hot-iron method for disbudding, which corresponds with 69.1% reported in the United States (USDA, 2008) but is lower than that reported in Canada (88.7%; Vasseur et al., 2010), southern Brazil (95%; Hötzel et al., 2014), Italy (90.6%; Gottardo et al., 2011), France (87%, Le Cozler et al., 2012; 87.6%, de Boyer des Roches et al., 2014), and EU member states (80.4%; Cozzi et al., 2015). The chemical method (caustic paste) was used on 24.5% farms, which is significantly higher than reported in other studies: 16% (Cozzi et al., 2015), 12.2% (USDA, 2008), 11% (Le Cozler et al., 2012), 11.6% de Boyer des Roches et al., 2014), 9% (Misch et al., 2007; Gottardo et al., 2011), and 6.1% (Vasseur et al., 2010). The use of the chemical method is influenced by specific legislation in several European countries (e.g., Germany, Austria, the United Kingdom) that restricts the use of caustic paste (ALCASDE, 2009). Some countries, such as Italy (ALCASDE, 2009) and Canada (NFACC, 2009), do not restrict the use of caustic paste. The application of caustic paste is associated with the need for individual housing of treated calves in the hours following the procedure to prevent accidental caustic burns to other animals (NFACC, 2009). According to our survey, 91.7% of herds disbudded only by the chemical method (caustic paste) housed their calves individually.

We found that the sex of disbudded calf influenced the method of disbudding. Calves were 4.5 times more likely to be disbudded by hot iron in herds where both heifers and bulls were disbudded than in herds where only heifers were disbudded ($P = 0.003$; Table 4). This

result may be influenced by the duration of the procedure; the hot-iron method is less time consuming than, for example, chemical methods. Breed and herd size did not have a significant effect on the disbudding method used ($P > 0.1$; Table 4).

Additionally, hot-iron cauterization is associated with the need for disinfection of surgical wounds to prevent inflammation and blow fly myiasis. We found that 70.6% farms that dehorned calves by hot iron used disinfection after the intervention. Regardless of the method used, the prevalence of using postoperative local disinfection is 70% in EU Member states (Cozzi et al., 2015).

Use of Medication

The majority (>90%) of surveyed farms did not use any pre- or post-procedure medication to mitigate pain (Table 3), a level even lower than the findings of Gottardo et al. (2011) in Italy, which reported the use of anesthetics in 10.4% of surveyed farms and pre-disbudding analgesics in 5%; in most cases, no postoperative medication was administered. Compared with these findings, the use of medication was slightly higher in the United States: Hoe and Ruegg (2006) reported the use of anesthetics on 17.9% of surveyed farms in Wisconsin and, according to USDA (2008), 17.7% of all farms in United States use analgesics or anesthetics during disbudding. In Canada, Misch et al. (2007) reported that 22% of dairy producers used local anesthetics; in France, 24% of farmers used anesthetics or analgesics (de Boyer des Roches et al., 2014); and in a Canadian survey by Vasseur et al. (2010), 44.7% of re-

Table 4. Disbudding practice according to breed, herd size, and category of disbudded calves

Variable	No. of farms	Statistics	Breed ¹	Herd size	Sex of disbudded calves
Age at disbudding:	98	Results	C > H	NS	NS
Modeling the probability to 28 d		df	1	1	1
		χ^2	5.28	0.62	1.07
		<i>P</i> -value	0.023*	0.433	0.301
		Odds ratio ²	2.800 (1.146; 6.843)	NR ³	NR
Methods: Modeling the probability of hot-iron	92	Results	NS	NS	Heifers and bulls > heifers
		df	1	1	1
		χ^2	0.96	1.68	8.59
		<i>P</i> -value	0.327	0.195	0.003**
		Odds ratio	NR	NR	4.450 (1.594; 12.422)

¹C = Czech Fleckvieh; H = Holstein.
²Numbers in parentheses are confidence limits for odds ratio.
³NR = not relevant.
* $P < 0.05$, ** $P < 0.01$.

spondents reported the use of pre-dehorning anesthetics but no analgesics. Overall, ALCASDE (2009) reported that 20% of European dairy farms used pain-mitigating drugs during the disbudding procedure. Higher prevalence (33%) of pain medication usage was reported in northern countries (e.g., Denmark, Estonia, Finland, Ireland, Sweden, and the UK) and the lowest (13%) prevalence was reported in southern countries (e.g., Cyprus, Greece, Italy, Portugal, and Spain; ALCASDE, 2009). According to the research in Brazil, no pain control was used for disbudding calves by smallholder/family farmers (Hötzel et al., 2014).

Despite previous research suggesting that calves should be considered in exactly the same manner as adult cattle (Graf and Senn, 1999; Hudson et al., 2008) and showing that pain may be even greater in neonatal animals (Murray and Leslie, 2013), European Council Directive 98/58/EC (European Union, 1998) allows the destruction or removal of the horn-producing area of animals younger than 4 wk of age without using any anesthesia. This may be one of the reasons for the limited usage of pain-relieving medication, despite the analgesia not only reducing the pain, but also attenuating suppressed leukocyte function during the procedure (Hulbert and Moisé, 2015).

The extra cost and the reluctance of veterinarians to perform disbudding could be another reason for the infrequent usage of analgesic and anesthetics drugs. In the Czech Republic, the average cost for the disbudding procedure, including the cost of medication (xylazine, procaine/lidocaine) and application of medication by a veterinarian is US\$3.95 to \$4.35 (US\$1 = 25.30 CZK), where the cost of medication accounts for 20 to 25% of the total cost, application 30 to 35%, and cautery and disinfection 40 to 50%. This cost is probably perceived by farmers as relatively high. This corresponds with previous results from Misch et al. (2007), who showed the cost of medication to be the most common reason for lack of use among producers in Ontario, Canada. However, another Canadian study confirmed this result only partly, because only 41% of veterinarians who do not use analgesic before disbudding agree (35.6% disagree), whereas only 23.9% of those who use analgesics definitely agree (53.9% disagree) with the proposition that farmers are unwilling to pay for analgesia (Hewson et al., 2007). Gottardo et al. (2011) showed that farmers were willing to pay less than half the true cost of treatment (\$0.35 to \$1.40 vs. the standard cost of medications of \$2.90 per calf). Another problem is that in some countries (including the Czech Republic), the farmers are not allowed to give the medication to the calves themselves—only a veterinarian can administer

the drugs legally (e.g., in Finland; Seppä-Lassila et al., 2016) and it is perceived by farmers as too expensive to have a veterinarian medicate calves before disbudding (Wikman et al., 2013; Hokkanen et al., 2015). A solution for this problem was suggested in Switzerland where the “anesthesia delegation model” (ADM) was introduced, where anesthesia may be administered by certified farmers. Alsaad et al. (2014) concluded that this is a promising model for increasing the usage of anesthesia during disbudding of calves. Currently, the topic is very important—in a North American survey, the majority (90%) of responders, which included both industry and non-industry stakeholders, thought that pain relief should be provided when disbudding and dehorning dairy calves (Robbins et al., 2015).

Previous research indicated a negative influence of herd size on the usage of local anesthetic (Gottardo et al., 2011), but Hoe and Ruegg (2006) did not find any statistical difference in the use of local anesthetics or tranquilizers between small and large herds. Because of the extremely limited usage of medication in our data set, we were not able to test this prediction.

Who Disbudded the Calves and How Were They Trained?

In the Czech Republic, the disbudding procedure was performed mainly by farm personnel (94.9%), which is comparable to other studies (Gottardo et al., 2011; Cozzi et al., 2015; Winder et al., 2016). The participation of a veterinarian or veterinary technician (graduate from secondary veterinary school) in the disbudding procedure was of minor importance (3.1%), even though recent research showed a positive influence on disbudding performed by veterinarian compared with farm personnel; for example, greater milk consumption and faster growth (Bates et al., 2015) or lower mortality risk (Seppä-Lassila et al., 2016). A low percentage of participation by veterinarians (1.4%) was reported in the largest herds in the United States (>500 cows; USDA, 2008), which corresponds with our result (our surveyed herds averaged 407 cows per farm).

The farm personnel who disbudded the calves were, in 46.9% of cases, trained by professional staff (veterinarian or veterinary technician), 37.8% were trained by other farm personnel, and 15.3% did not receive training. Previous research from Italy showed that 30.2% of farmers were trained by professional staff (veterinarian or milk quality inspector), 43% of respondents received training from another farmer, and 26.8% received no training and learned the technique on their own (Gottardo et al., 2011). In contrast, when focusing just on

Table 5. Farmers' opinions on behavioral responses and painfulness of disbudding procedure

Criterion (variable)	Specification	All herds		Czech Fleckvieh		Holstein	
		No.	%	No.	%	No.	%
Observed behavioral changes in calves after disbudding (head waggling, head rubbing against the wall, drooping ears, aversion of milk, other behavioral changes)	Observed behavioral changes	66	67.3	33	64.7	33	70.2
	Cannot assess	24	24.5	14	27.5	10	21.3
	Do not observe any changes	8	8.2	4	7.8	4	8.5
Is the disbudding is painful?	Not painful	6	6.1	5	9.8	1	2.1
	Mild pain	20	20.4	8	15.7	12	25.5
	Moderate pain	45	45.9	25	49.0	20	42.6
	Severe pain	15	15.3	6	11.8	9	19.2
	Cannot assess	12	12.3	7	13.7	5	10.6
How long does the pain last?	Minutes	39	39.8	19	37.2	20	42.6
	Up to 6 h	20	20.4	13	25.5	7	14.9
	Up to 12 h	8	8.2	3	5.9	5	10.6
	More than 12 h	9	9.2	5	9.8	4	8.5
	Cannot assess	22	22.4	11	21.6	11	23.4

larger farms (>200 cows), 40% of farmers were trained by veterinarians and 20% of farmers did not receive training (Gottardo et al., 2011), which corresponds with our results and our average herd size.

Farmers' Opinions on Disbudding Procedure

We also investigated farmers' perceptions of the pain associated with the disbudding procedure and what behavior they observed thereafter. The results are listed in Table 5. Previous research has shown that the pain

accompanying disbudding causes several physiological and negative behavioral responses, regardless of the method used (e.g., Vickers et al., 2005; Stafford and Mellor, 2005, 2011; Heinrich et al., 2010; Mintline et al., 2013; Caray et al., 2015). In line with this, two-thirds of surveyed farmers were able to observe the calves' behavioral responses such as head shaking or rubbing against a wall, loss of appetite (aversion of milk), drooping ears, or other behavioral changes. In contrast, 24.5% were not able to assess and 8.2% did not observe any behavioral changes, a very low incidence

Table 6. Farmer's opinion according to breed, herd size, and category of disbudded calves

Variable	No. of farms	Statistics	Breed	Herd size	Sex of disbudded calves
What can be observed in calves after disbudding?	98	Results	NS	NS	NS
		df	1	1	1
		χ^2	0.65	0.38	0.35
		P-value	0.419	0.539	0.554
		Odds ratio	NR ¹	NR	NR
Painfulness of disbudding: Modeling the probability of higher value-greater pain	86	Results	NS	NS	Heifers and bulls > heifers
		df	1	1	1
		χ^2	0.28	0.11	3.05
		P-value	0.598	0.738	0.081†
		Odds ratio ²	NR	NR	2.158 (0.903; 5.154)
How long does the pain last? Modeling the probability of lower value-shorter period	76	Results	NS	Larger > smaller	NS
		df	1	1	1
		χ^2	0.04	3.59	1.26
		P-value	0.847	0.058†	0.262
		Odds ratio	NR	1.229 (0.982; 1.539)	NR

¹NR = not relevant.

²Numbers in parentheses are confidence limits for odds ratio.

†P < 0.10.

compared with a previous study where 26.3% of Italian farmers with herd size >200 cows never observed any behavioral changes (Gottardo et al., 2011). We did not find a significant influence of breed, herd size, or sex of disbudded calves on the farmer's ability to observe any behavioral changes after disbudding ($P > 0.1$; Table 6), which is in agreement with a previous study where breed and herd size did not have a significant influence on behavior observed after disbudding (Gottardo et al., 2011).

Most surveyed farmers estimated the accompanying pain to be mild or moderate (20.4 and 45.9% of respondents, respectively). These results are in accordance with other previous studies; for example, in the United States, 42% of respondents estimated that disbudding causes little or no pain and 40% considered it to involve moderate pain (Hoe and Ruegg, 2006), or in Italy, where more than 40% of farmers perceived postoperative pain to be moderate (Gottardo et al., 2011). In contrast, a study from Finland showed a better understanding of the pain involved in disbudding procedures: 69% of respondents estimated disbudding-related pain to be severe, and 63% agreed with the statement "The calf requires pain medication for disbudding" (Hokkanen et al., 2015). Similar results were found in another Finnish study by Wikman et al. (2013). When Canadian veterinarians were asked, 58% of respondents estimated the disbudding procedure to be "very painful" (Hewson et al., 2007). We found a tendency for the sex of the disbudded calves to influence farmers' opinion of how painful disbudding is for calves; on farms where both sexes were disbudded, the odds ratio for farmers to consider a higher level of pain intensity was 2.16 times higher than on farms where only heifers were disbudded ($P = 0.08$; Table 6). Breed and herd size did not influence the farmers' opinion on how painful disbudding is for calves ($P > 0.1$; Table 6).

In previous research, the maximum pain response was observed within the first 30 min after disbudding (Stafford and Mellor, 2011; Stock et al., 2013), followed by plateau level of pain for at least 3 h (Stilwell et al., 2009) or up to 8 h (Stock et al., 2013). Furthermore, differences in behavior, which may indicate pain in calves after disbudding, were detected 24 h after the procedure (Faulkner and Weary, 2000). However, little is known about chronic pain in the days following disbudding (Stafford and Mellor, 2011). The latest research shows that wounds after hot-iron disbudding remain painful for at least 3 wk (S. J. J. Adcock and C. B. Tucker, both from Center for Animal Welfare, Animal Science, University of California, Davis, 2017, personal communication) and wounds after hot-iron branding are sensitive at least 8 wk (Tucker et al.,

2014). In our survey, 39.8% of farmers estimated that the pain lasts just minutes or up to 6 h (20.4%), which is slightly lower than in a previous study by Gottardo et al. (2011), where 48% estimated that the pain lasts only a few minutes or less than 6 h (43%). We found a tendency for the effect of herd size on farmers' opinion on how long the pain lasts ($P = 0.058$; Table 6): the larger the herd size, the more likely was the farmer to estimate a shorter duration of pain. On the other hand Gottardo et al. (2011) and Hoe and Ruegg (2006) did not show an effect of herd size on farmers' opinion of postoperative pain duration. The breed and sex of the disbudded calves did not affect farmers' opinion on how long the pain lasts ($P > 0.1$, Table 6), which is in accordance with findings of Gottardo et al. (2011).

CONCLUSIONS

Our study was based on a sample of farms with larger herd sizes than previous studies. On dairy farms with hundreds of cows, actual herd size has little influence on disbudding practice and attitudes. Furthermore, the type of breed kept on a farm might influence disbudding practices, even though farmers' opinions about pain associated with disbudding did not differ by breed. Based on the low usage of painkilling drugs and farmers' attitudes to pain intensity and duration caused by disbudding, professional training in disbudding practice is needed for farm personnel, especially to show the advantages of using pre- and post-procedure pain-mitigating medication to decrease behavioral reactions and to improve calves' welfare and production characteristics. For further improvement of welfare in the period around disbudding, it is important for veterinarians to cooperate with farmers to highlight the importance of this topic and to open the discussion on using medications. The Swiss "anesthesia delegation model" can be seen as a positive example of progress.

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