

Study investigating the attitudes and opinions of cattle farmers and veterinarians in the UK on the use of non-steroidal anti-inflammatory drugs (NSAIDs) for post-disbudding analgesia of calves

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Abstract

The study examined cattle farmers' and veterinarians' opinions of pain-induced distress associated with disbudding and attitudes towards non-steroidal anti-inflammatory drugs (NSAIDs). An emphasis was placed on investigating pain perception, veterinary-client communication and factors influencing analgesic use. Data were collected from an online questionnaire, links to which were published in professional periodicals, promoted by industry organisations and distributed on private practice mailing lists. A total of 110 veterinarians and 116 farmers who regularly disbud calves completed the questionnaires. Of the respondents, 56% of veterinarians and 14% of farmers routinely use NSAIDs for disbudding. Respondents perceived disbudding to be severely painful without medication and 82% of veterinarians and 43% of farmers perceived post-procedural pain to persist beyond 24 h. There was a significant difference between female and male veterinarians' pain scores for disbudding without medication. Veterinarians underestimate the influences of welfare and analgesic duration and effectiveness on farmers' decisions and overrated cost impact. The study highlights that improvements in veterinarian-farmer communication regarding calf disbudding analgesia are required; both in terms of refining veterinarians' understanding of farmers' priorities and guiding clients on methods to improve calf welfare.

Keywords: analgesia, animal welfare, calves, disbudding, non-steroidal anti-inflammatory drugs (NSAIDs), veterinarian and farmer

Introduction

Disbudding and dehorning are routine husbandry practices (Stafford & Mellor 2005) used to reduce the likelihood of injury to personnel and other cattle (*Bos taurus*) (Misch *et al* 2007). Horn injuries can cause significant pain and distress, as well as damaging the carcass and hide, resulting in financial penalties (Stewart *et al* 2009). Dehorning involves the amputation of the horn, while disbudding is the destruction of horn germinal tissue in young calves to prevent horn growth. The Department of Environment, Food and Rural Affairs (DEFRA 2003) recommends that calves are disbudded prior to two months of age, ideally as soon as the horn bud is palpable, which varies between breeds (Stafford & Mellor 2005). Under the United Kingdom's (UK) Protection of Animals (Anaesthetics) Act 1954/1964, all methods of disbudding and dehorning require a corneal nerve local anaesthetic (LA) blockade. The only exception being chemical cauterisation in calves less than one week old (DEFRA 2003). Thermal cauterisation with LA blockade is the recommended method for disbudding in the UK.

A number of studies have investigated physiological and behavioural indicators of the pain-induced distress associ-

ated with disbudding of calves (McMeekan *et al* 1998; Graf & Senn 1999; Grondahl-Nielsen *et al* 1999; Earley & Crowe 2002; Sutherland *et al* 2002; Gibson *et al* 2007; Stewart *et al* 2008; Heinrich *et al* 2010; Coetzee *et al* 2012; Stilwell *et al* 2012; Allen *et al* 2013). These studies similarly concluded that disbudding is a painful procedure which, without pain-relief, causes pain and suffering. It has been suggested that post-disbudding pain persists for up to 24 h (Faulkner & Weary 2000) and potentially 44 h (Heinrich *et al* 2010). It is generally considered that the LA used for disbudding and dehorning are effective at providing nerve blockage for up to 2 h (Heinrich *et al* 2009; Stafford & Mellor 2011). However, that can result in a period post-procedure where the LA blockage has worn off, with the animal experiencing pain and distress, particularly from the inflammatory response in the wound.

Non-steroidal anti-inflammatory drugs (NSAIDs) are routinely used in companion animal (Dohoo & Dohoo 1996a,b; Capner *et al* 1999; Lascelles *et al* 1999) and equine practice (Waran *et al* 2010), however their usage is sometimes overlooked in farm animals (Barrett 2004; Whay & Huxley 2005) and they are not routinely used for disbud-

ding or dehorning of cattle in the UK. NSAIDs are prescription-only medicines (POM-V), for which farmers require the authorisation of a registered veterinarian to use (NOAH 2015; RCVS 2015). The use of NSAIDs in combination with LAs have been shown to reduce post-disbudding pain in calves (McMeekan *et al* 1998; Faulkner & Weary 2000; Stewart *et al* 2009; Heinrich *et al* 2010; Stilwell *et al* 2012), virtually eliminating the cortisol-stress response when compared to LA alone (Stafford *et al* 2003; Heinrich *et al* 2009; Stafford & Mellor 2011; Allen *et al* 2013). Furthermore, NSAIDs have been shown to increase feed intake (Duffield *et al* 2010; Heinrich *et al* 2010) and growth rates (Faulkner & Weary 2000) in calves post-procedurally. However, despite the large body of scientific evidence on the effectiveness of NSAIDs for reducing the pain and distress associated with disbudding, farmers and veterinarians in the UK do not routinely use them during disbudding. Furthermore, there are currently no legislative requirements for the usage of NSAIDs for disbudding in the UK, it is at the discretion of the farmer/veterinarian carrying out the procedure.

Questionnaire-based studies have investigated the opinions of British (Capner *et al* 1999; Lascelles *et al* 1999) and Canadian (Dohoo & Dohoo 1996a,b) veterinarians towards pain and analgesia in companion animals. Similar studies have explored veterinarian and farmer perceptions of pain and analgesia in cattle in relation to various conditions and procedures (Watts & Clarke 2000; Fitzpatrick *et al* 2002; Whay & Huxley 2005; Huxley & Whay 2006, 2007; Hudson *et al* 2008; Lorena *et al* 2013), with a number of studies conducted outside of the UK (Hoe & Ruegg 2006; Hewson *et al* 2007; Misch *et al* 2007; Vasseur *et al* 2010; Gottardo *et al* 2011; Lorena *et al* 2013; Wikman *et al* 2013, 2016; Norring *et al* 2014; Hokkanen *et al* 2015). However, there is currently a lack of detailed information on the opinions and awareness of UK veterinarians and farmers on the usage of NSAIDs for disbudding and the potential reasons for why they are not more commonly used.

The aim of the study was to examine the attitudes and opinions of UK cattle farmers and veterinarians on the pain associated with disbudding, analgesia and the use of NSAIDs for disbudding of calves. With an emphasis on pain perception, demographic factors, veterinary-client communication, economics and other factors influencing potential NSAID usage.

Materials and methods

Two matched online questionnaires were developed with specific questions adapted towards the target populations. The questionnaires were designed to investigate cattle farmers' and veterinarians' opinions on the pain associated with disbudding and the usage of NSAIDs and can be seen in the supplementary material to papers published in *Animal Welfare* on the UFAW website: <http://www.ufaw.org.uk/t-ufaw-journal/supplementary-material>. The study and questionnaires were approved by the Royal Veterinary College Research Ethics Committee.

Questionnaire design

A number of questions were adapted from previous research (Whay & Huxley 2005; Huxley & Whay 2006, 2007; Gottardo *et al* 2011). Questions were primarily closed-ended with appropriate categories, including 'don't know' to avoid selection bias. Questionnaires examined: participant demographics; education; awareness of cattle pain and analgesia; detailed disbudding practices; and factors influencing NSAID usage. The perception of pain duration and severity experienced by calves during disbudding (with various analgesic protocols) was examined with a numerical scale adapted from previous studies (Watts & Clarke 2000; Fitzpatrick *et al* 2002; Whay & Huxley 2005; Hewson *et al* 2007; Huxley & Whay 2007). Influences of various factors on NSAID usage (potential side-effects, cost, availability, anti-inflammatory/toxic effects, support, veterinary advice, availability, duration of action, administration, dose, licensing, withdrawal period), were assessed on a Likert scale adapted from Whay and Huxley (2005). Previously, in a survey by Huxley and Whay (2007), the majority of participants stated 'less than £5' was an acceptable price for NSAIDs. Therefore, in the current survey, the cost question focused on the £0 to £5 range.

Survey distribution and analysis

The surveys were made available online via SmartSurvey (Smartline International Ltd, UK) with access via web links or Quick Response (QR) codes. The study was promoted via newsletters and adverts produced by various organisations (EBLEX, DairyCo, NFU, BCVA, NADIS, Farmers Weekly) and on private practice mailing lists. A prize was offered as an incentive.

After collation, data for participants who do not disbud were removed. Prior to analysis, data were categorised and certain responses combined. Pain-scales were treated as categorical variables. In *Results*, 'pain perception' refers to pain scale and post-procedural pain duration responses and 'analgesia' refers to NSAIDs and does not consider other drugs, such as opioids. Analysis of the standard drugs used for disbudding was made with exclusion of those respondents citing the use of caustic pastes (veterinarians: $n = 2$; farmers: $n = 13$), as neural blockade and analgesia are not a requirement for this method.

Statistical analysis

Data were analysed using SPSS (Version 22, IBM Corporation, Chicago, IL, USA) and rejected where questions were not completed. Categorical variables were analysed for associations with the Chi-squared tests or Fisher's exact test when appropriate. The Kolmogorov-Smirnov test was used to determine the distribution of continuous data. Continuous data were non-parametrically distributed. Differences between veterinarian and farmer responses for post-procedural pain duration, duration of action and price were analysed with either Mann-Whitney *U* or Kruskal-Wallis tests. The level of significance for all tests was $P < 0.05$.

Results

A total of 118 veterinarians and 140 farmers completed the questionnaires, of which 93 ($n = 110$) and 83% ($n = 116$), respectively, regularly disbudded calves. Data from those respondents who do not disbud calves were not included in subsequent analysis.

Demographics

All veterinary respondents practiced within the UK and 93% ($n = 102$) were UK graduates. With representatives from seven UK veterinary schools (excluding University of Surrey). Eight (7%) respondents were from overseas veterinary schools. The median year since graduation was 9.5 (year of graduation range 1973–2014). There was an even gender distribution of veterinary respondents (50% male; 50% female) ($n = 110$). The median proportion of time working with cattle was 80% (interquartile range [IQR]: 50–95%). Seventy respondents (64%) had participated in cattle-related, post-graduate training.

Farmer respondents were from across the UK. There was an uneven gender distribution of 71 males (61%) and 39 females (34%), six individuals did not answer this question. Ninety-two (79%) respondents had more than 20 years of farming experience (range: < 5–> 50 years). Most respondents owned farms (64%; $n = 74$) and cattle were the main enterprise (74%; $n = 86$). Beef and dairy cattle farmers represented 59 ($n = 68$) and 31% ($n = 36$) of respondents, respectively, with smallholders, breeders and conservation grazers making up the remaining 10%. Median herd size was 150 cattle (range: 0–1,200). Beef farmers had significantly smaller cattle herds (median: 153, IQR: 62–200) than dairy producers (median: 323, IQR: 140–478) ($P < 0.0001$).

Disbudding practices

There was no significant difference between beef and dairy farmers in the reasons or methods used for disbudding calves. Eighty percent ($n = 93$) of all farmers reported that they disbud to prevent injury, 13% ($n = 15$) disbud for financial reasons, and 4% ($n = 5$) for aesthetic purposes. Seven (47%) of those disbudding for financial reasons rated cost as very important, whilst the majority disbudding for safety concerns rated it as less important ($n = 27$; 29%) ($P = 0.038$).

On the farms that disbud, the procedure was carried out by: farm personnel 86% ($n = 100$), veterinarians 11% ($n = 13$), contractors 2% ($n = 2$), and students 1% ($n = 1$). The disbudding methods used by veterinarians included: blow torch and hot iron (52%; $n = 57$), gas-powered cauteriser (45%; $n = 49$), mechanical (scoop) disbudding (7%; $n = 8$), electronic cauterisation (5%; $n = 5$) and caustic paste (2%; $n = 2$), with 6% ($n = 7$) of these using a combination of methods. Meanwhile, the methods used by farmers included: gas-powered cauteriser (59%; $n = 69$), blow torch and hot iron (19%; $n = 22$), electronic cauterisation (11%; $n = 13$), caustic paste (11%; $n = 13$), mechanical (scoop) disbudding (3%; $n = 4$), or a combination of methods (4%; $n = 5$). Fifteen farmer respondents (13%) reported that they were also introducing polled genetics into the herd (10 beef and 5 dairy producers). Twenty-four (21%) farmers stated

they do not disbud when asked, 71% ($n = 17$) of these were beef producers (8% dairy, 21% other). Of the farmers that do not disbud, 50% ($n = 12$) said they breed polled cattle, 17% ($n = 4$) dehorned at a later stage, 8% ($n = 2$) did not disbud due to ethical/welfare reasons and six chose not to answer the question. Most veterinarians (94%; $n = 102$) and farmers (93%; $n = 108$) reported that they disbud calves under eight weeks old. Five veterinarians (5%) and eight farmers (7%) reported that they disbud after eight weeks. There were no significant associations between disbudding age/method with perceptions of pain/analgesic use.

Knowledge of pain and analgesia

Veterinarians reported that they gained their knowledge from clinical experience (47%; $n = 52$) and undergraduate training (21%; $n = 23$). There was little difference in the sources of knowledge on cattle pain and analgesia between veterinarians that routinely use or do not use NSAIDs for disbudding. The only association found was that veterinarians that routinely use NSAIDs accessed literature-based NSAID information (papers, articles, commercial literature, datasheets, etc) more often than those that do not use NSAIDs ($P = 0.009$). Sixty-seven percent ($n = 70$) of veterinarians stated that their knowledge of cattle pain and analgesia was adequate, of this 66% routinely used NSAIDs for disbudding. There was a significant association between perceived level of knowledge and the routine use of NSAIDs for disbudding ($P = 0.019$). There were no associations between knowledge/training and veterinary pain perceptions.

Seventy-two percent of farmers ($n = 84$) reported their knowledge of disbudding analgesia to be adequate, there was no significant difference between beef and dairy producers. Farmers reported that they gained their knowledge through tradition (36%; $n = 42$), training courses (31%; $n = 36$), veterinarians (27%; $n = 31$) and media (5%; $n = 6$). There were no significant associations between information sources and NSAID usage amongst farmers. When asked where farmers would seek advice if they were considering introducing NSAIDs to their disbudding protocol, 94% ($n = 109$) stated they would approach their veterinarian. Other responses included professional farm management advisors, fellow farmers/meetings and information resources (ie internet, articles, leaflets). Almost 20% of farmers stated a combination of these resources but none reported that they would seek advice from drug company representatives.

Perception of the pain associated with disbudding

Veterinary and farmer responders rated the severity of disbudding-induced pain with different analgesic protocols (Table 1). Veterinarians and farmers were similar in the ranking of the severity of pain associated with disbudding with the different analgesia protocols. Significantly more female (51%; $n = 28$) compared to male (26%; $n = 14$) veterinarians scored disbudding as severely painful (pain severity score 10) ($P = 0.029$). There was no association between gender, farm type and the scoring of pain severity of disbudding for farmers. There was a significant association between groups (veterinarians/farmers) and the perception of post-disbudding pain duration ($P < 0.001$; Table 2).

Table 1 Median and range of the ratings of pain severity and duration in calves undergoing disbudding with different analgesic protocols by veterinarians and farmers.

Disbudding pain severity	Veterinarians		Farmers	
	Median	Range	Median	Range
Without medication*	9	6–10	9	0–10
Without local anaesthetic*	2	0–9	2	0–10
Without local anaesthetic and NSAID*	2	0–9	1	0–8

* Rated on a 10-point scale; 0 = no pain at all, 10 = worst pain imaginable.

Respondents answering 'don't know' to these questions have been removed prior to data analysis.

Table 2 Veterinarian and farmer perceptions of post-disbudding pain-duration (number and %).

Duration of post-disbudding pain	Veterinarians (%)	Farmers (%)	P-value
No pain	0 (0%)	1 (1%)	ns
Minutes	0 (0%)	7 (6%)	< 0.05
< 6 h	4 (4%)	15 (13%)	< 0.05
< 12 h	2 (2%)	8 (7%)	ns
< 24 h	11 (10%)	21 (18%)	ns
> 24 h	90 (82%)	50 (43%)	< 0.05
Don't know	3 (3%)	14 (12%)	< 0.05

Table 3 Frequencies (%) of drugs reported for routine use for cautery and mechanical methods of disbudding by veterinarians and farmers.

	Drugs routinely used for disbudding; number (%)				
	Local anaesthetic	NSAIDs	Alpha ₂ agonist	No drugs used	Don't know
Veterinarians (n = 108)	106 (98%)	60 (56%)*	2 (2%)	1 (1%)	0 (0%)
Farmers (n = 103)	89 (86%)	14 (14%)*	0 (0%)	3 (3%)	11 (11%)

* Significant difference between farmers and veterinarians ($P < 0.001$).

Data have been excluded for respondents using caustic paste.

Eighty-two percent of veterinarians reported that the pain of disbudding lasted > 24 h, compared to 43% of farmers ($P < 0.05$). Twelve percent of farmers reported they did not know how long post-disbudding pain lasted, compared to 3% of veterinarians ($P < 0.05$). There was a significant association between veterinarian use of NSAIDs and perception of post-disbudding pain ($P = 0.02$), with 51% of veterinarians that routinely use NSAIDs reporting that the pain lasted > 24 h, compared to 31% who do not use NSAIDs.

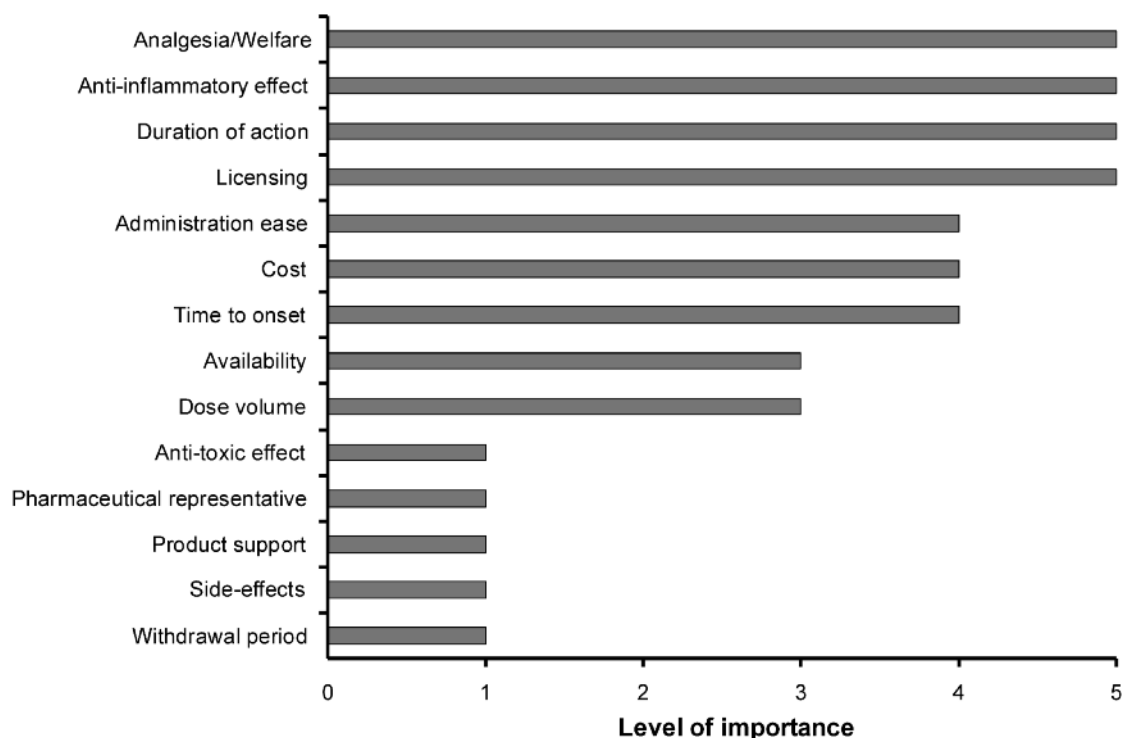
Disbudding drugs

Drugs used by respondents during disbudding are detailed in Table 3. One hundred and six (98%) and 89 (86%) veterinarians and farmers, respectively, reported that they routinely use LA when disbudding. In addition, 60 (56%) and 14 (14%) veterinarians and farmers (eight beef and six dairy producers), respectively, reported that they routinely

use NSAIDs when disbudding ($P < 0.001$). Of respondents using NSAIDs, all farmers (100%) and 84% of veterinarians (51%; $n = 48$) reported that the drug used was meloxicam. Veterinarians also reported using flunixin meglumine (7%; $n = 4$) and ketoprofen (2%; $n = 1$). Seventy-nine percent ($n = 87$) of veterinarians identified meloxicam as the UK-licensed NSAID for disbudding. Veterinarians reported having permission to use NSAIDs on a median of 13% of their clients' farms (range: 0–100).

There was a significant difference ($P < 0.001$) between responses of farmers and veterinarians in their preference for calves to receive disbudding analgesia. Sixty-one (56%) veterinarians compared to 26 (22%) farmers stated they would prefer if calves received NSAIDs for disbudding, there was no difference between farmer type. While 48% of farmers indicated that they may be interested in the use of

Figure 1



Modal values of responses of veterinarians on the importance of various factors on the decision to use NSAIDs for calf disbudding, measured on a Likert scale (1 = not important, 2 = slightly important, 3 = fairly important, 4 = quite important, 5 = very important).

NSAIDs. There was a significant association between veterinarian pain scores for disbudding without any pain relief and a preference for clients to use NSAIDs for disbudding ($P = 0.033$). Fifty-four veterinarians (49%) reported that NSAIDs should be made compulsory for disbudding. There was a significant association between veterinarians' opinions on compulsory use of NSAIDs and number of years since graduation ($P = 0.015$), where newer graduates were more in favour of their use.

Factors affecting the use of NSAIDs for disbudding

Veterinarians were asked to rate the importance of fourteen factors on their decision to use NSAIDs for calf disbudding (Figure 1). The following factors were rated as very important in influencing their decision to use NSAIDs: analgesia and welfare (77%); anti-inflammatory effect (57%); duration of action (63%); and licensing (57%) (modal value). Administration ease (45%), cost (34%) and time to onset (45%) were rated as quite important. Veterinarians routinely using NSAIDs significantly scored analgesia/welfare ($P = 0.015$) and duration of action ($P = 0.019$) as more important, while cost was scored as less important ($P = 0.001$) compared to those not using NSAIDs. The majority of veterinarians scoring analgesia/welfare as very important, also perceived pain to persist > 24 h (64%; $n = 70$) ($P = 0.016$). Of the 31% of veterinarians who said that

pain persists > 24 h but did not use NSAIDs, the factors they reported as very important in influencing their decisions regarding NSAIDs were: analgesia and welfare (75%); duration of action (64%); anti-inflammatory effect (61%); and licensing (58%). Meanwhile, administration ease (50%), time of onset (47%) and cost (36%) were rated as quite important. Twenty-three percent ($n = 25$) of veterinarians thought that all their farming clients would prefer calves to receive NSAIDs for disbudding. While 71% ($n = 78$) reported that some of their clients would prefer calves to receive NSAIDs.

Similar to the veterinarian ratings, farmers were asked to rate the importance of eleven factors in relation to considering NSAID usage for disbudding calves. In addition, veterinarians were also asked to rate these same factors from the perspective of the farmer (their perceived perspective) (Table 4). Fifty-three percent of farmers (58% beef and 42% dairy farmers) rated analgesia and welfare as very important compared to just over one-quarter of veterinarians (27%) ($P = 0.001$). Veterinarians significantly underestimated how important farmers rated onset ($P < 0.001$), duration of action ($P < 0.001$), side-effects ($P < 0.001$), licensing ($P < 0.001$) and product support ($P < 0.001$). Eighty-two farmers (71%) (70% beef and 74% dairy farmers) stated that veterinary recommendation was very or quite important, however this was not significantly different to the veterinarians' perspective of the farmers' concerns. Conversely, veterinarians significantly

Table 4 Importance of factors relating to farmers' decision on the implementation of NSAIDs for disbudding, from both the farmer and the veterinarian (median responses). All factors were on a Likert scale (1 = not important; 2 = slightly important; 3 = fairly important; 4 = quite important; 5 = very important).

Factor influencing NSAID use for disbudding	Median response of farmers		Median response of veterinarians from a farmers' perspective		P-value
	Median	Range	Median	Range	
Analgesia and welfare	5	1–5	4	2–5	0.001
<i>Pharmacokinetics</i>					
Onset of action	4	1–5	3	1–5	< 0.001
Duration of action	4	1–5	4	1–5	< 0.001
Side-effects	4	1–5	2	1–5	< 0.001
Withdrawal	1	1–5	2	1–5	< 0.001
Licensing	4	1–5	2	1–5	< 0.001
<i>Product</i>					
Veterinary recommendation	4	1–5	4	1–5	ns
Availability	4	1–5	4	1–5	ns
Administration ease	4	1–5	4	1–5	0.002
Product support	3	1–5	2	1–5	< 0.001
<i>Cost</i>					
Cost and labour	3	1–5	5	2–5	< 0.001

overestimated the importance of withdrawal periods ($P < 0.001$) and ease of administration ($P = 0.002$).

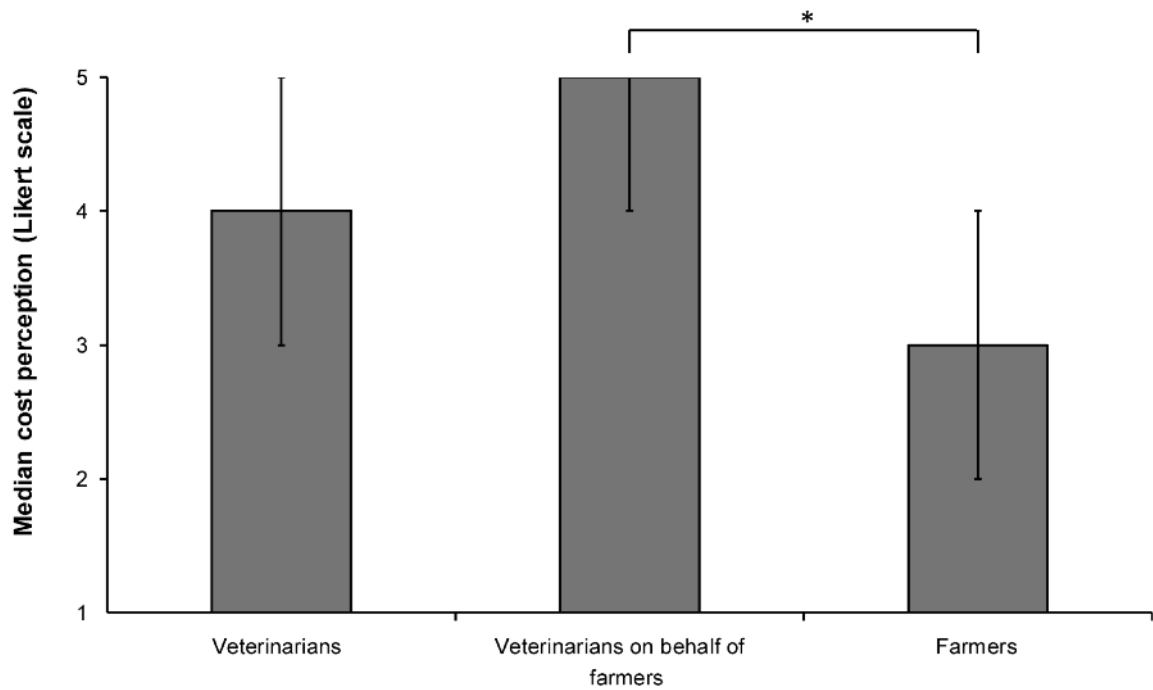
Sixty-four percent of veterinarians thought that the most important concern of farmers was cost. However, only 18% of farmers (19% beef and 16% dairy farmers) reported cost as a very important factor when considering NSAID usage; veterinarians significantly overestimated the importance of cost and labour to farmers ($P < 0.001$) (Figure 2). Farmers were asked what price per calf they would consider acceptable for NSAIDs for disbudding. Seventy-three percent of farmers (74% beef and 71% dairy farmers) responded that a dose less than £2 per calf would be acceptable (Figure 3). When broken down 37, 36, 16 and 1% of farmers reported that they thought < £1, £1–2, £2–5 and > £10, respectively, were acceptable costs per dose. Similarly, veterinarians were asked what cost per dose they thought would be acceptable to their clients (farmers). Sixty-six percent said the cost would have to be less than £2 to be acceptable (33% < £1; 34% £1–2; 24% £2–5). Only 2% of farmers responded that they would be unwilling to pay for NSAIDs, compared to 7% of veterinarians stating that farmers would be unwilling to pay. For veterinarians there was a significant association between the perception of disbudding pain duration lasting > 24 h and those that stated a higher acceptable price for NSAIDs ($P = 0.034$). Furthermore, veterinarians that routinely used NSAIDs reported that farmers would find £2–5 an acceptable cost per dose of NSAIDs ($P < 0.001$).

Veterinarian-client communications

When asked whether veterinarians discussed cattle analgesia enough, there was a significant difference between the groups with 71 and 45% of veterinarians and farmers, respectively, stating the subject was not discussed enough ($P < 0.001$). Seventy-eight percent of veterinarians reported that they had discussed the use of NSAIDs with their clients. Overall, 29% of farmers said they have had discussions with their veterinarians on the use of NSAIDs for disbudding. Dairy farmers were more likely to have these discussions with 41% reporting talking to their veterinarians about NSAIDs compared to 25% of beef farmers. Of the farmers that reported they have discussed NSAIDs for disbudding with their veterinarian, 29% routinely used NSAIDs, while 71% did not ($P < 0.001$). In total, 101 farmers said they do not use NSAIDs, of these 72% reported that they have never discussed disbudding analgesia with their veterinarian.

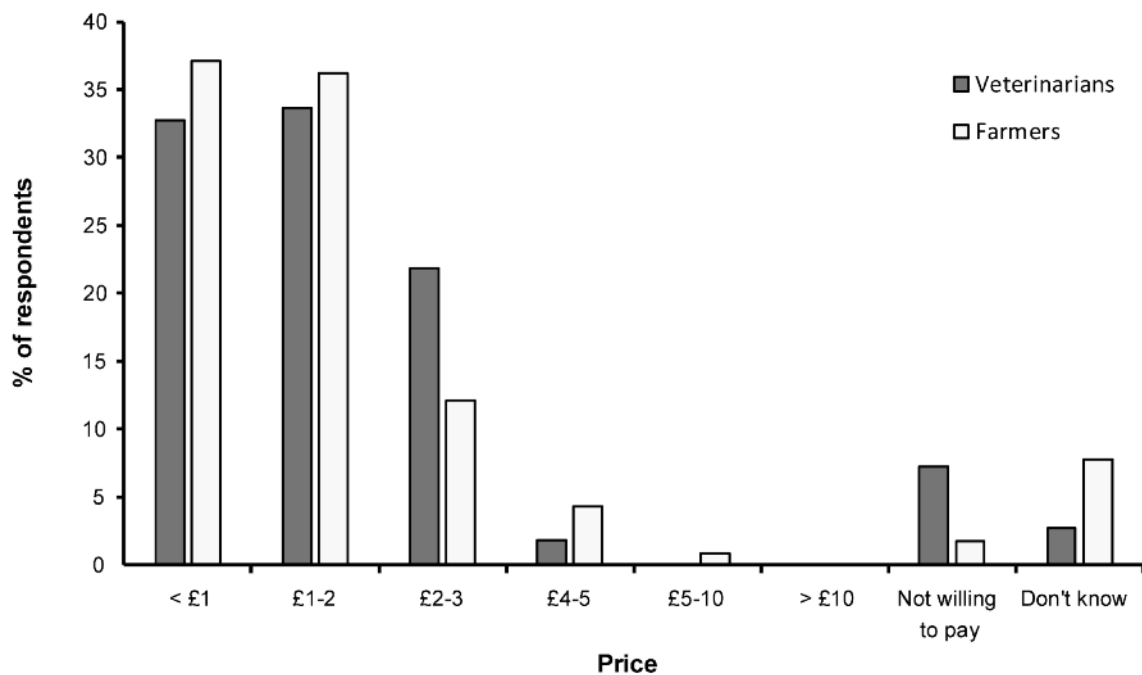
Veterinarians that perceived post-disbudding pain to persist > 24 h were more likely to have discussed the use of NSAIDs with their farming clients ($P = 0.001$). Generally, veterinarians who discussed NSAID usage with their clients spent significantly more time working with cattle, than those who did not ($P = 0.025$). These same veterinarians were more likely to be permitted to use NSAIDs on their clients' farms ($P < 0.001$).

Figure 2



Median ratings (\pm IQR) of the importance of cost to farmers ($n = 116$) and veterinarians ($n = 110$) on the incorporation of NSAIDs for disbudding, veterinarians were also asked to state their perception of the importance of cost to their farming clients. * Denotes a significant difference ($P < 0.001$). Likert scale: 1 = not important; 2 = slightly important; 3 = fairly important; 4 = quite important; 5 = very important.

Figure 3



The dosage costs per calf that farmers ($n = 116$) and veterinarians thought farmers ($n = 110$) would find acceptable to pay for NSAIDs for disbudding.

Discussion

This is the first detailed study comparing the attitudes and opinions of UK veterinarians and farmers on the use of NSAIDs for disbudding of calves. There were disparities in responses between veterinarians and farmers on the: influence of veterinarians on analgesia choices; importance of cost; and welfare. However, almost all veterinarians and most farmers favoured NSAID use, with most veterinarians stating that some (71%), if not all of their clients (23%), would prefer calves to receive NSAIDs. Likewise, approximately half of veterinarians think NSAIDs should be made compulsory for disbudding.

Current practices

The disbudding of calves is a routine husbandry practice which, when practiced without adequate pain relief, can result in significant pain and distress. In the study, the majority of farmers (86%) and veterinarians (98%) reported that they routinely used LA when disbudding. In addition, 5 and 7% of veterinarians and farmers, respectively, reported that they were disbudding calves after eight weeks of age. The disbudding of calves without LA and over eight weeks of age could be considered a breach of the Protection of Animals (Anaesthetics) Act 1954/1964; Veterinary Surgeon Act 1996; Animal Welfare Act 2006; and DEFRA Code of Recommendation for the Welfare of Livestock (Cattle). However, care must be taken with these results as the response was open-ended, so this does not necessarily mean that participants are not using LA, even if they have not stated its use. Potentially, veterinarians who did not state LA may have used general anaesthesia for calves older than eight weeks old. Local anaesthesia for disbudding is not routinely used in a number of overseas countries, although it is widely agreed that the procedure is painful (Hoe & Ruegg 2006; Gottardo *et al* 2011). It is worth noting that several respondents stated use of lidocaine preparations which are not currently licensed for use in UK food-producing animals (Reg [EC] 37/2010) (European Commission 2010).

The most commonly used disbudding methods for both groups involved cauterisation of the horn bud and surrounding tissue. This is consistent with the findings of Cozzi *et al* (2015), who reported that cauterisation was the most common method in EU member states. Cauterisation produces third-degree burns, damaging nociceptors and resulting in desensitisation (Doherty *et al* 2007). Furthermore, it has been associated with reductions in plasma cortisol concentrations compared to other dehorning methods, suggesting a reduced pain response (Petrie *et al* 1996; Stafford & Mellor 2011). Interestingly, 13% of the farmers reported that they were introducing polled genetics into their herds. This was a higher proportion than that reported by Kling-Eveillard *et al* (2015) (9%) in a survey of farmer attitudes in Italy, Germany and France. The breeding of polled animals would remove the need for disbudding and dehorning. The polled genotype is dominant over the horned, with the gene located on the proximal end of Bovine chromosome 1 (Georges *et al* 1993; Brennehan *et al* 1996). There has been resistance to the induction of

polled genetics, based on the concern that selection of the polled allele might result in: lower breeding values for preferred production traits and the potential for high relatedness and inbreeding due to the lower range of available sires and genetic diversity (Kling-Eveillard *et al* 2015; Windig *et al* 2015). However, as more farmers and breeding companies start to introduce polled genetics, the number of sires with higher genetic merit is increasing, making polled genetics a viable alternative to current practices.

Fifty-six percent of veterinarians used NSAIDs for disbudding; this was significantly greater than that reported in similar studies by Huxley and Whay (2006) (disbudding: 1.7%; dehorning 2.6%) and Misch *et al* (2007) (dehorning 1.5%). Meanwhile, 14% of farmer responders reported that they use NSAIDs, this proportion was higher than previously reported by Gottardo *et al* (2011) (5%) and Vasseur *et al* (2010) (0%) in north-eastern Italy and Canada, respectively, but was significantly less than Finnish farmers (48%) (Hokkanen *et al* 2015). In addition to regional differences in veterinary and farming practices, a possible reason for this apparent increase in usage by both groups may be increased awareness of the benefits of NSAIDs and the recent registering of meloxicam (under brand name of Metacam™ in the UK) for disbudding and dehorning in calves in the EU. Indeed, Huxley and Whay (2006) observed a similar proportion of veterinarians reporting the use of NSAIDs in calves for other procedures and conditions (eg sole ulcers, claw amputations, dystocia, Caesarean section, etc). Alternatively, the sample could have been biased, as individuals with a greater concern for welfare, analgesia or awareness of the registering of meloxicam may have been more likely to participate in a survey of this type.

Pain, analgesia and knowledge

Both veterinarian and farmer respondents agreed that disbudding without medication is severely painful and that this pain can be reduced with the use of LA. This finding is consistent with the existing literature, guidelines and minimum standards. Veterinarian pain-scores were higher and within a narrower range than reported by Huxley and Whay (2006) (median: 9; range: 6–10) versus median 7 (range: 2–10), respectively). This difference may be because the current study focuses solely on disbudding, without estimation of pain alongside that of other procedures, meanwhile Huxley and Whay (2006) examined the attitudes relating to a range of procedures and conditions. Meanwhile, the pain score results in the current study were similar to those of Finnish veterinarians and clinical veterinary students as reported by Norring *et al* (2014), who also reported a positive association between disbudding pain scores (without pain relief) with higher human empathy scores.

Farmers generally perceived disbudding as less painful with a LA+NSAID compared to LA alone, however, veterinarians scored them equally. This is an interesting finding and suggests that research on disbudding and NSAIDs may not be finding its way into cattle practice. To ensure adequate advice is being provided to clients it is important that veterinary surgeons are up-to-date with recent developments in the

profession. An alternative explanation is that as farmers spend more time with their livestock post-procedure than veterinary surgeons, they are more likely to have observed the benefits of LA+NSAIDs for post-operative pain. Whereas the financial demands of farm animal veterinary practice means veterinarians seldom have the time to observe calves post-procedure prior to leaving to visit other clients.

In the study, female veterinarians scored disbudding without medication as significantly more painful than their male counterparts but there was no such relationship with the farmers. Dohoo and Dohoo (1996a) found similar findings for veterinarians in a study of companion animal practitioners' opinions on post-operative pain and analgesia. However, in studies which also included disbudding, no significant associations were found between gender and opinions on post-operative pain in veterinarians (Huxley & Whay 2006; Hewson *et al* 2007). Years since graduation in the current study had no bearing on veterinarian perception of pain during disbudding, which was similar to the findings of Hewson *et al* (2007). However, Huxley and Whay (2006) reported that older graduates assigned higher pain scores to disbudding without pain relief. Conversely, Dohoo and Dohoo (1996a) found that recent graduates perceived companion animals to experience more post-operative pain compared to more experienced peers. Despite the lack of association between years since graduation and perception of pain of disbudding in the current study, it was found that newer graduates were more likely to agree that NSAIDs should be made compulsory for disbudding.

It is important to note that there has been significant debate regarding the subjectivity of pain scales. The issue is that pain scales by their very nature are subjective, open to interpretation bias and do not take account of the multidimensionality of pain (Krebs *et al* 2007). However, in many situations they are the only available method for the assessment of opinions on painful husbandry practices. Also, despite these limitations, numerical scoring systems with carefully designed questionnaires are now recognised as sensitive methods for quantifying attitudes in regards to pain, simplifying data for collection and analysis (Jensen *et al* 1994; Williamson & Hoggart 2005; Hjermsstad *et al* 2011).

It has been previously reported that post-disbudding pain can persist beyond 24 h (Faulkner & Weary 2000; Heinrich *et al* 2010). In the study, almost twice the number of veterinarians than farmers stated that post-disbudding pain persists beyond 24 h. This difference in perception may be attributable to veterinarians' training (undergraduate/post-graduation continuing professional development [CPD]), specifically awareness of pain-induced behaviours displayed in calves, or awareness of recent research. Indeed, veterinarians perceiving pain to persist beyond 24 h stated that analgesia/welfare featured highly in their analgesic choices. In an Italian study, most farmers perceived pain to diminish within 6 h (Gottardo *et al* 2011), a view shared by a minority in the current study.

This could be due to cultural differences or variations in farming systems in other countries compared to the UK. Fifty-one percent of veterinarians that reported that post-disbudding pain persists beyond 24 h were routine NSAID users. The duration of analgesia and its effectiveness was reported as more important to veterinarians who routinely use NSAIDs than to non-users. This suggests that clinicians' perceptions of animal suffering has an important influence on analgesic choices. However, it is disconcerting that 31% of veterinarians that reported that post-disbudding pain persisted beyond 24 h did not use NSAIDs. It is unclear from the results the reasons for this seemingly contradictory response. When asked what were the most important factors in influencing their decision on NSAID usage, the results effectively mirrored those of the veterinarians that do use NSAIDs. Potential factors that could have contributed to their decision not to use NSAIDs may relate to internal and external pressures, such as client wishes, practice policy, perception of importance of cost to the farmer, lack of dissemination of current best practice and even an unwillingness to change practices. These factors were not covered in the survey.

Compared to the studies of Lorena *et al* (2013) (16%) and Whay and Huxley (2006) (46%), the current study found that sixty-seven percent of veterinarians considered their knowledge of cattle pain and analgesia to be adequate. This is consistent with the findings of Hewson *et al* (2007) (75%) on attitudes of Brazilian large animal clinicians. The differences between the studies may be due to changes in: (i) awareness of post-operative pain in the past ten years — interestingly, there was little change in the reported sources of the information on pain relief by veterinarians in the current study and those of Lorena *et al* (2013) and Whay and Huxley (2005); (ii) veterinary school curriculums and teaching filtering through into practice — 62% of veterinary respondents had graduated within the last five years and veterinarians using NSAIDs were more likely to access information on them via literature (papers, articles, commercial literature, datasheets, etc); and (iii) due to the recent registration and increased advertising of Metacam™ to cattle veterinarians.

Only 16% of farmer respondents felt their knowledge of cattle pain and analgesia to be insufficient. This is in contrast to almost two-thirds of farmers eight years ago (Huxley & Whay 2007). In the current study, however, knowledge of analgesia related specifically to disbudding, whilst the Huxley and Whay (2007) study explored more generalised opinions on cattle. This may indicate that farmers are more aware of analgesia for disbudding of cattle compared to other procedures and conditions (eg surgical castration, joint ill, fractures etc). Alternatively, it may suggest that awareness or education on the use of pain-relief for procedures has improved since the previous study. However, this could not be determined from the current study.

Veterinary-farmer communication

Most farmers reported that they seek advice about analgesia from their veterinarian and indicated that this advice can be highly influential on their decisions. Similarly, veterinary respondents highlighted the importance of veterinary-client communications. However, 45% of farming respondents reported that veterinarians do not discuss cattle analgesia enough. This is a similar proportion as reported by Huxley and Whay (2007) (53%) in a larger survey of attitudes in relation to use of analgesics in cattle (all procedures). Seventy-one percent of veterinarians also reported that disbudding analgesia was not discussed enough. In the current study, 71% of farmers have never discussed NSAIDs for disbudding with their veterinarian. Yet 78% of veterinarians said they had discussed NSAIDs with their clients. This disparity suggests a disconnection in veterinary-client communication on the topic of NSAIDs, suggesting that more work is needed to improve the dialogue between veterinarian and client. However, these findings must be interpreted with caution as the surveys were not veterinarian/client matched, regional effects were not tested and the sample size of both populations was not large, which could have introduced regional-based bias. Veterinarians that had discussed NSAIDs with their clients were more likely to respond that post-disbudding pain persisted beyond 24 h, these responders also generally spent more of their time working with cattle. This is similar to the findings of Hewson *et al* (2007) for Canadian veterinarians.

One discouraging finding in the study was that of the farmers that had discussed NSAIDs for disbudding, only 29% routinely used them, while 71% did not. This suggests that veterinary advice, although rated important by farmers in the decision-making processes, does not always help to influence behavioural change. Ajzen (1991) proposed with the theory of planned behaviour that an individual's intention to engage in a behaviour (such as adoption of NSAIDs for disbudding) is influenced by the interaction of attitude towards the behaviour, subjective norms and perceived behavioural control. In the context of analgesia and disbudding, the lack of uptake of NSAIDs by farmers could be influenced by attitude to the changes in practice, how these changes will be perceived by others (peers, veterinarians, suppliers, buyers, public etc) and how the farmer perceives the ease or difficulty of the new practice (practicality, skill, perceived barriers) (Godin & Kok 1996). Generally, the more positive the attitude and the subjective norms, combined with greater perceived control, the more likely the intention is to perform the behaviour.

Both groups had similar concerns about analgesia onset, duration and effectiveness, however, veterinarians underestimated the impact that these factors have on farmer decision-making. In addition, veterinarians underestimated the influence of NSAID side-effects, licensing and product support on farmers and overestimated the importance of withdrawal periods and administration ease. Suggesting that veterinarians do not always correctly

perceive or understand the motivation and concerns of their clients in relation to animal welfare. Veterinarians also overestimated the impact of cost/labour to the farmers, which is similar to the findings of Huxley and Whay (2006) and Kristensen and Enevoldsen (2008). These distorted perceptions of farmer motivations and concerns could potentially affect the type of advice that veterinarians offered to their clients, which could have impacts on welfare and production. Despite this, the majority (66% veterinarians; 73% farmers) of both groups agreed on an acceptable NSAID price of less than £2 per calf, which supports the findings of Huxley and Whay (2007). According to a specified list price for meloxicam of £1.97 per 100 kg (Hudson *et al* 2008; Wern Veterinary Surgeons price 2015), NSAIDs would be a viable option for the majority of respondents in the current study. Veterinarians who indicated that the pain associated with disbudding persisted for a longer period were more likely to state that farmers would be willing to pay a higher price for NSAIDs. Similarly, a study by Hewson *et al* (2007) reported an association between the unwillingness to pay for analgesia with lower pain scoring. Veterinarians, who indicated they do not use NSAIDs, generally rated cost importance higher and stated lower acceptable prices (less than £1) compared to NSAID users. These findings highlight the importance of improving veterinary-client communication around the subject. As it suggests that some veterinarians may not be adequately discussing NSAIDs options with their clients due to preconceived notions of farmer perceptions and priorities. It is an essential part of veterinary medicine that all realistic analgesic options are communicated with clients to allow them to make informed decisions for the care of their livestock.

Animal welfare implications and conclusion

In conclusion, this study highlights an inadequacy in veterinary-client communications in conveying the practicalities and potential benefits of using NSAIDs. Importantly, veterinarians underestimate the influences of welfare, and analgesic duration and effectiveness on farmers' decisions and overrated cost impact. This perception could have a negative effect on veterinary recommendation and should be addressed.

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