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Pain evaluation in dairy cattle

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ABSTRACT

Pain compromises the welfare of animals. A prerequisite for being able to alleviate pain is that we are able to recognize it. Potential behavioural signs of pain were investigated for dairy cattle with the aim of constructing a pain scale for use under production conditions. Forty-three cows were selected and fifteen different behaviours were scored, subsequently a clinical examination was performed to allocate the cows to a pain and non-pain group. The animals were then treated with an analgesic or a placebo and after a resting period the cows were re-scored by two observers blinded to the treatment. Six behaviours were found to be significantly different between the pain and non-pain group and robust enough to be included in the pain scale: 'attention towards the surroundings' 'head position', 'ears position', 'facial expressions', 'response to approach' and 'back position' (a seventh, piloerection, was also significant but seemed difficult to use as it changed rapidly; $p < 0.05$ for all measures). The Cow Pain Scale is the sum of the score for the aforementioned behaviours. For each individual animal before and after treatment, it was significantly lower after analgesic treatment ($p = 0.003$) in the ClinPain group but not after placebo treatment ($p = 0.06$); the pain score did not differ significantly before compared to after treatment with analgesic or placebo for the non-pain group ($p = 0.2$; $p = 0.1$). A second study was conducted to further validate the Cow Pain Scale. Cows from two herds were randomly selected ($n = 119$) and their behaviour scored by two observers. Subsequently the cows were clinically examined and allocated to a pain and non-pain group ($n = 96$, 23 cows were excluded because of incomplete examination). The cows from the pain group scored higher on The Cow Pain Scale compared to the non-pain group for both observer I ($p < 0.0001$) and observer II ($p = 0.0001$). For the two observers the sensitivity of the Cow Pain Scale was calculated to 0.61/0.75 and the specificity to 0.75/0.75 with a weighted Kappa of 0.62. In conclusion the Cow Pain Scale has the potential to be applied for the assessment of pain in dairy cattle under production conditions.

1. Introduction

Pain is an important animal welfare problem, not least in cattle (Huxley and Whay, 2006; Hewson et al., 2007; Kielland et al., 2009; Laven et al., 2009; Thomsen et al., 2010; Fajt et al., 2011). Veterinarians are expected to be able to diagnose, grade and treat pain in cattle. Large differences in analgesic treatment practices are related to age and gender of the veterinarian but also attributed to cost and availability of analgesics (Huxley and Whay, 2006). One reason for the inconsistence of pain relief for cattle is the inadequate ability to assess pain (Flecknell, 2008). Pain assessment based on physiological parameters has proven inapplicable as these are often unspecific and sensitive to stress as well as being difficult to measure on-farm (Hansen, 1997). Therefore, pain assessment based on behaviour has received increasing attention as this principle has been applied to assessment in Nellore cattle after castration and in several other species (Holton et al., 2001; Pritchett et al., 2003). Three classes of behaviours, useful for pain evaluation of animals, have been proposed (Weary et al., 2006): (1) pain specific behaviours, (2) a change in certain behaviours that the animals are very motivated to perform (e.g. feeding) and (3) preference choices. While preference choices are suitable for research purposes, pain specific behaviours and to a lesser extent the change in certain normal behaviours are more practically useful. However, the change in normal behaviours is not a readily usable measure as it necessitates long observation times.

Pain specific bovine behaviours described in veterinary textbooks are often behaviours that are linked to diseases believed to

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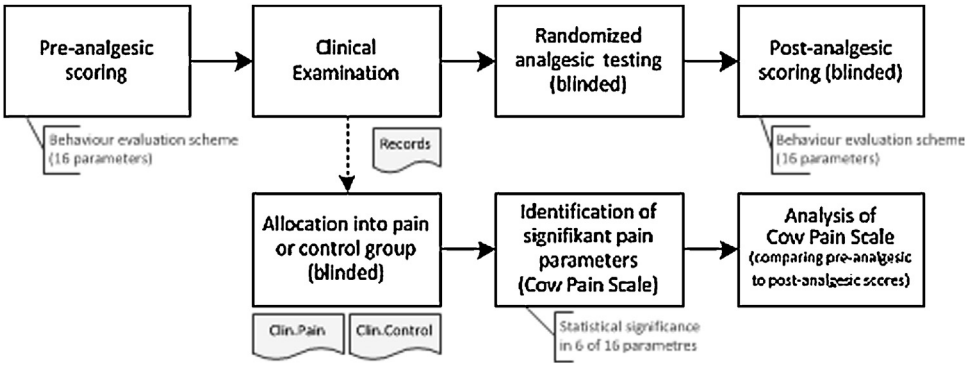

Fig. 1. Flow diagram of study I.

be extremely painful, such as acute toxic mastitis, fractures, septic arthritis and peritonitis (Huxley and Whay, 2006). These pain behaviours comprise: changed posture (crouching, arched back, low head position), severe lameness, attention towards the painful area, vocalization, teeth grinding (bruxism), and modification of social behaviour (Sanford et al., 1986; Short, 1999; O'Callaghan et al., 2003; Sandem et al., 2006; Radostits et al., 2007; Hudson et al., 2008; Chapinal et al., 2010; Leslie and Petersson-Wolfe, 2012). The behaviours range from obvious to subtle but occurrence, grading or co-existence with diagnoses has never been established. Cattle are often described as stoic, i.e. they do not display obvious pain behaviour. However, during the last decade, research in a number of other supposedly stoic prey species, e.g. horses (Dalla Costa et al., 2014; Gleerup et al., 2015), rats (Sotocinal et al., 2011), mice (Langford et al., 2010) and rabbits (Keating et al., 2012), have shown that subtle changes in behaviour are good predictors of pain, among these facial expressions (Leach et al., 2012). To the knowledge of the authors facial expressions of pain in cattle have not been described in detail but considering recent research within this field, it is highly likely that similar facial cues of pain exist in cattle.

The overall aim of this study was to identify possible pain-specific behaviours in dairy cattle and to combine these into a practically useful pain scoring tool. The focus of the study is on pain behaviours that are exhibited by dairy cattle under commercial conditions. The specific aims of the study were (1) to construct a pain scale by investigating the occurrence of behaviours expected to be related to pain in cows with and without pain and subjected to analgesic or placebo treatment (study I), and (2) to investigate the practical performance of this pain scale in randomly selected cows with different observers (study II).

2. Study I

To confirm suspected pain, analgesic testing is a gold standard method (Weary et al., 2006). If a given specific clinical sign of pain is reduced or eliminated after the analgesic treatment, the animal was most likely to have been experiencing pain before the treatment. This type of analgesic testing has good specificity but poor sensitivity as absence of effect may be caused by inefficiency of the chosen analgesic on certain types of pain, rather than the sign was not caused by pain. In this study, analgesic testing was employed and selected behaviours were scored before and after treatment. Cows were selected on day 1 and behaviour was scored (afternoon) according to selected behavioural parameters. On day 2, the cows were subjected to a clinical examination and then treated with an analgesic or a placebo. After a resting period, a second behaviour score was performed (afternoon). Post hoc, the cows were divided into a pain group (ClinPain) and a placebo group (ClinPlac) based on the findings of the clinical examination (for an outline of the study, see Fig. 1).

2.1. Animals, materials and methods

The experimental protocol was approved by the Danish Animal Experiments Inspectorate.

2.1.1. Herds

Three herds of >150 Danish Holstein dairy cows, loose housed on slatted floors were included in the study. All herds had a monthly advisory consultancy with a veterinarian, following Danish legislation. The herds were collected as convenience sampling.

2.1.2. Animals

Inclusion criteria were: lactating cows >2 weeks after calving with no veterinary diagnosis. As many cows as possible were examined in the herds within the study period; approximately 10–12 cows per day. Fifty cows were included but to be able to study pain behaviour as opposed to sickness behaviour two cows were excluded post hoc due to rectal temperature >39.2 °C). An additional five cows were excluded due to lack of claw examination. Forty-three cows were included in the study.

2.1.3. Behaviour evaluation scheme

The behaviour evaluation was based on pain behaviours selected from the literature (Morton and Griffiths, 1985; Sanford et al., 1986; Short, 1999; O'Callaghan et al., 2003; Sandem et al., 2006; Radostits et al., 2007; Hudson et al., 2008; Chapinal et al., 2010; Leslie and Petersson-Wolfe, 2012). The behaviours included in the behaviour evaluation scheme is described in detail in Table 1. All behaviours were weighted and graduated in 3–5 levels (see Supplementary material table X) as some behaviours are considered more pain specific than others and therefore should be more weighty in the final pain score sum (Gleerup and Lindegaard 2015). Specifications of the 'bovine pain face' and ear positions (Fig. 2a and b) were modelled after the Equine Pain Face (Gleerup et al., 2015), modified by the information from observing six healthy experimental cows before and after analgesic treatment following a standard rumen fistulation surgery. These observations were performed by the first author, who was already trained in the evaluation of the Equine Pain Face. Lameness is traditionally used as an indicator of orthopaedic pain but was excluded from the list of investigated pain behaviours, since it was included in the clinical examination and thus used to validate the behaviours in Table 1.

2.1.4. Behavioural and clinical examination

Only cows in cubicles or walking areas were included. To increase the probability of including a balanced number of cows with and without pain, cows were selected and temporarily allocated into two groups, based on a visual inspection from the distance. This inspection discriminated between sound looking cows (TempContr), that were bright and alert and cows with an