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Monitoring pain in animals using behaviour

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ABSTRACT

The behaviour of an animal is used to identify and evaluate pain. However, simple active behaviours may not be sufficient for these purposes. Several different scales and experimental protocols have been developed for use in clinical and experimental circumstances. The use of control groups and different analgesic treatments has allowed the identification of behaviours related to particular painful stimuli. Pain threshold monitoring, self-administered analgesic trials and choice tests are furthering our understanding of an animal's response to painful stimuli and procedures. These protocols combined with physiological, immunological and production indices are allowing for a better understanding of the effects of painful stimuli on animals. However, the interpretation of behaviour remains difficult and evaluating pain in a non-human species remains controversial.

Keywords: pain; behaviour; analgesics; pain-thresholds.

INTRODUCTION

That the behaviour and demeanour of an animal are obvious indicators of pain is a widely accepted belief. But is this really the case? When an injury or a disease incapacitates an animal physically and its normal functions are not easily performed, then the behaviour may reflect the degree of incapacitation and not necessarily the pain being experienced. Again, if specific behaviours are beneficial to recovery and convalescence then those may indicate a recovery process rather than pain *per se*. Thus, behaviour and demeanour may not reflect pain but may reflect incapacity or indicate convalescence. Incapacity may of course cause distress by limiting an animal's ability to escape from potential predators, but this psychological state is not pain.

The behavioural responses to painful stimuli have five purposes (Molony & Kent, 1997) that may increase an animal's chances of survival in either the short or long term:

- (1) withdrawal and escape responses of a body part or the whole animal to prevent further damage
- (2) reduced activity to maximise wound healing and convalescence and possibly to minimise pain
- (3) agonistic activity to stop another animal or human from inflicting more damage
- (4) learning activity which allows an animal to avoid damaging circumstances in the future
- (5) appealing activity to elicit help from other animals

In a clinical setting behaviours thought to indicate that an animal is in pain have been listed by Morton & Griffiths (1985) and Sandford *et al.* (1986) but these have not been validated. Correlations between pain and behaviour have been poorly defined in animals under clinical conditions and people tend to use empathic projection and behavioural observations as the method of evaluation.

The evaluation of pain in animals by simple description of behaviour, numerical rating scales (NRS) or visual analogue scales (VAS) has been shown to be unreliable in the assessment of acute pain in dogs (Holton *et al.*, 1998a). Conzemius *et al.* (1997) and Holton *et al.*

(1998b) demonstrated a poor correlation between a numerical rating system and physiological parameters associated with pain in dogs (heart rate, respiratory rate, pupil dilation). Subsequently, Holton *et al.* (2001) developed a scale to measure pain in dogs using a set of 47 words and expressions used by veterinarians. It was a more detailed scale than anything previously developed but was not compared with the physiological responses of dogs. In contrast, a VAS where clinicians assessed pain on a scale of 1 to 10 and numerical rating scales on which clinicians rank pain by giving specific values to particular behaviours were useful in assessing pain in sheep (Welsh *et al.*, 1993).

A visual analogue scale was developed by Thornton & Waterman-Pearson (1999) for lambs after castration used three types of behaviour. It included active pain behaviours such as foot stamping which are easily visible to the observer, unresponsive behaviours evaluated when the observer enters a pen and interacts with the lambs, and response to palpation of the scrotum. This scale gave more detailed information about the behaviour of lambs than using active pain behaviours which had been the favoured method by previous workers (Moloney *et al.*, 1993; Lester *et al.*, 1996; Dinniss *et al.*, 1999).

As pain is a subjective experience it is impossible to measure it in animals. However, specific scientific protocols may be used to determine how an animal responds physiologically and behaviourally to different painful stimuli and to determine whether behaviour may be used to identify pain and evaluate to some extent its severity and alleviation.

Scientific protocols investigating the behavioural responses of animals to pain are of three basic types: (1) observational studies where treated groups (animals subjected to specific painful treatments, injured or diseased animals) are compared with control groups and groups receiving effective analgesia; (2) choice studies where animals are allowed to avoid or choose painful or non-painful treatments or to self-medicate with different analgesics to alleviate pain; and (3) trials measuring the response to defined painful stimuli such as pressure,

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thermal or electrical stimuli. Clinical studies usually compare the behaviour of animals under clinical conditions with some animals receiving analgesics and some not (Fox *et al.*, 2000).

There is a major question as to whether behaviour is more or less sensitive as an index of pain than physiological parameters such as heart rate, respiration rate, pupil diameter, plasma cortisol response etc. This question is particularly important where there are conflicts between the behaviour and cortisol responses (Mellor *et al.*, 2000).

In the rest of this paper we outline a series of observations based on research into the behavioural responses of livestock to various husbandry practices.

A behaviour may identify pain IF it is seen during and after a specific tissue-damaging injury, disease or procedure but not seen in healthy or non-damaged animals, i.e., control animals

This is an intuitive observation and one used to identify pain in animals all the time. The posture, demeanour, activity and vocalisation of injured animals that are different from their healthy peers are used routinely as indicators of pain. The inactivity of an animal after abdominal surgery is often taken to indicate pain. The escape activity of an animal during dehorning, branding or castration is interpreted to indicate that pain is being experienced.

It is possible to identify specific behaviours that occur only, or much more frequently, after specific injuries if the injured animals and their uninjured peers are observed and their behaviour compared. For example, lambs castrated by rubber ring are restless, standing up and lying down frequently during the 45 minutes after castration, while non-castrated lambs or those castrated surgically (Lester *et al.*, 1996) or by clamp (Dinniss *et al.*, 1999) are much less restless. However, animals that are injured or subjected to a painful procedure may not behave differently from their healthy herd-mates, particularly in the days following the treatment (Stafford *et al.*, 2000). This is expected as prey species try to avoid drawing attention to themselves because of the danger of predation.

A behaviour may identify nociception and, by inference, pain, if it is seen during and after a specific tissue-damaging procedure but not seen when local anaesthesia is delivered.

The use of local anaesthetic allows for the identification of behaviours that are evoked specifically by nociception. If a behaviour occurs after treatment but does not occur when local anaesthesia is used, then that behaviour is likely to be evoked by nociception elicited within or near the damaged tissue. Escape behaviours seen during procedures such as castration are not seen if effective local anaesthetic is used (Stafford *et al.*, 2002). Behaviours which are seen or are not seen in the hours after the damage is caused, but are not seen or seen, respectively, if local anaesthetic is used, are also easily identified. For example grooming occurs regularly in calves during the two hours after amputation dehorning when local anaesthetic is used but not if local anaesthetic

is not used (Stafford *et al.*, 2000).

A behaviour may identify pain if it is present after a painful experience but is not present when effective analgesics are used

Tail shaking is a common behaviour during the first six hours after calves have been dehorned by amputation (McMeekan *et al.*, 1999). This is reduced for the first two hours after dehorning when local anaesthetic is given. The administration of ketoprofen (a non-steroidal anti-inflammatory drug) plus a local anaesthetic, reduces the amount of tail shaking for six hours after dehorning. Tail shaking is thus a useful behaviour to monitor the pain experiences by calves after dehorning (McMeekan *et al.*, 1999).

A behaviour may be injury specific

Different noxious treatments, injuries or diseases may elicit unique behavioural responses because the sensations experienced by an animal may differ when different tissues are injured or similar tissues are damaged in different ways. Thus, surgical castration and/or tailing of lambs cause immobility whereas ring castration and/or tailing cause increased activity (Malony *et al.*, 1993; Lester *et al.*, 1996; Dinniss *et al.*, 1999).

The expression of different unique behaviours in response to different treatments makes it difficult to use behaviour alone to compare the relative level of pain experienced by animals subjected to different experiences (Mellor & Holmes, 1988). If behaviour is to be used to compare the pain experienced by animals, there needs to be a continuum of expression of a single behaviour in response to different treatments (Lester *et al.*, 1996).

Behaviour can be used to identify the duration of pain

The two features of pain of interest are duration and intensity. A pain-related behaviour may be used to determine the duration of pain if its duration is supported by at least one other method of assessing duration. Thus, if the behaviour is present throughout a plasma-cortisol pain response, and absent before and after it, then the behaviour may be justifiably used to monitor the duration of acute pain.

However, many behaviours, such as escape behaviours, are present only during the actual procedure and do not occur throughout the pain experience. These behaviours may reflect a specific acute type of pain that the cortisol response does not accurately identify (Mellor *et al.*, 2000). Some behaviours do occur throughout the cortisol response, for example, statue standing and other forms of abnormal standing and walking occur throughout the cortisol response to surgical castration and tailing (Lester *et al.*, 1996). In contrast, restlessness, lateral recumbency while awake and normal lying while asleep occur during the early, middle and late phase, respectively, of the cortisol response to ring castration and tailing (Mellor & Murray, 1989; Mellor *et al.*, 1991; Molony *et al.*, 1993).

The behaviour of animals subject to normal husbandry procedures is usually similar to that of control animals

by 24 hours after treatment (Stafford *et al.*, 2000). Thus, at this stage, either treated animals are not experiencing much pain, or behaviour is not useful as an indicator of pain. However, with some clinical conditions, such as lameness in cattle or foot rot in sheep, behaviour appears to reflect pain in the longer term.

Behaviour can be used to evaluate the severity of pain

Moloney *et al.* (1993) attempted to produce a behaviour scale related to pain experienced by lambs after castration and tailing. They suggested that an increase in restlessness may indicate an increase in pain, that lateral recumbency indicates more pain than ventral recumbency, that extension of the hind limbs reflects more pain than flexion and that more abnormality of walking and standing indicate more pain. This type of scale has been developed for other species and is based more on human experience and empathy than on rigorous scientific findings.

Animals will choose the lesser of two painful experiences and this indicates what they prefer

Many painful husbandry procedures such as castration and dehorning are carried out only once and are not suitable for choice type protocols. However, other repeatable procedures can be used as aversion tests (e.g., electroejaculation which may be painful; Stafford *et al.*, 1996), demand tests (Matthews & Ladewig, 1994) or choice tests, in order to assess the pain caused by such procedures. Animals appear to learn where painful procedures occur and subsequently avoid such places.

Self-administration of analgesics may be used to monitor pain

This methodology has been used on poultry to determine the painfulness of lameness in broilers (Danbury *et al.*, 2000), and in laboratory animals, but it has not been used in ruminants at this stage.

Change in nociceptive thresholds may be used to monitor pain

Changes in the response to mechanical (pressure), electrical and thermal stimuli have been used to assess the presence of hypoalgesia or hyperalgesia in animals following husbandry procedures (Thornton & Waterman-Pearson, 1999), tourniquet application (Welsh & Nolan, 1994) or chronic painful diseases such as foot rot (Welsh & Nolan, 1995) in sheep. Castration of lambs by ring did not alter mechanical nociception significantly, but castration by surgical methods or combining ring and clamp elevated nociceptive thresholds for seven and four hours, respectively, after castration (Thornton & Waterman-Pearson, 1999). Ring castration or amputation dehorning of calves did not alter their nociceptive threshold to thermal or mechanical stimulus in the weeks following treatment (K.J. Stafford & D.J. Mellor, unpublished observation).

Many different techniques are being used to develop an understanding of the behavioural responses of animals to painful stimuli, disease, injury and surgical intervention.

More and more attempts are being made to combine behavioural, physiological, immunological and production parameters in order to improve our ability to quantify the pain experience of animals. The interpretation of the results from such studies remains difficult and it remains an issue whether we can accurately define the pain experience of animals.

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