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Monitoring equine visceral pain with a composite pain scale score and correlation with survival after emergency gastrointestinal surgery

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ABSTRACT

Recognition and management of equine pain have been studied extensively in recent decades and this has led to significant advances. However, there is still room for improvement in the ability to identify and treat pain in horses that have undergone emergency gastrointestinal surgery. This study assessed the validity and clinical application of the composite pain scale (CPS) in horses after emergency gastrointestinal surgery. Composite pain scores were determined every 4 h over 3 days following emergency gastrointestinal surgery in 48 horses. Inter-observer reliability was determined and another composite visceral pain score (numerical rating scale, NRS) was determined simultaneously with CPS scores.

CPS scores had higher inter-observer reliability ($r = 0.87$, $K = 0.84$, $P < 0.001$), compared to NRS scores ($r = 0.68$, $K = 0.72$, $P < 0.001$). Horses that survived without complications had significantly lower CPS and NRS scores compared to horses that were euthanased or had to undergo re-laparotomy ($P < 0.001$). Breed and the location in the intestinal tract (small or large intestine) did not influence pain scores. In conclusion, the use of the CPS improved objectivity of pain scoring in horses following emergency gastrointestinal surgery. High inter-observer reliability allows for comparisons between different observers. This will be of great benefit in larger veterinary hospitals where several attending clinicians are often involved in the care of each case.

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Introduction

Pain recognition and management in animals are important in the optimisation of animal welfare and have received increasing attention in recent decades. As a result, considerable progress has been made (Viñuela-Fernández et al., 2007; Flecknell, 2008; Lerche, 2009). However, several surveys among veterinarians working with companion animals (Hugonnard et al., 2004; Williams et al., 2005; Hewson et al., 2006), farm animals (Hewson et al., 2007a, 2007b; Laven et al., 2009) and horses (Price et al., 2002; Dujardin and van Loon, 2011) have shown that further improvement is needed. In the study by Dujardin and van Loon (2011), a large proportion (40–60%) of veterinary practitioners classified their own ability to recognise pain and knowledge of analgesic therapy in horses as only moderate. Continuing education and research in pain management will help to improve methods for objective and reproducible pain assessment and so support the development of newer analgesic drugs and more refined analgesic techniques, which will consequently have a positive effect on welfare (Valverde and Gunkel, 2005).

In general, pain is an aversive sensory and emotional experience representing awareness by the animal of damage or threat to the integrity of its tissues. The experience of pain may have an effect on several physiological parameters and the animal may change its physiology and behaviour with the aim to reduce or avoid damage, to reduce the likelihood of recurrence and to promote recovery (Molony and Kent, 1997). As pain is a complex multidimensional experience expressing itself in behavioural, physiological, and emotional variables, there is no single parameter that specifically indicates the presence of pain (Büttner and Finke, 2000; Lerche, 2009).

Simple descriptive scales used to classify pain as absent, mild, moderate or severe are suboptimal and largely inadequate instruments for pain evaluation in animals, not in the least due to poor inter-observer reliability (Lindegaard et al., 2010). Combined interactive and observational multifactor pain behaviour rating scales, used together with physiological parameters, have been proposed

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as more sensitive in identifying and documenting changes instigated by pain in animals (Abbott et al., 1995; Dobromylskyj et al., 2000). Such composite pain scales (CPS) have been described in horses for orthopaedic (Bussières et al., 2008; Lindegaard et al., 2010) and for visceral pain (Pritchett et al., 2003; Graubner et al., 2011). The disadvantage of both visceral pain scales is that they contain a subjective pain score element. Further, the multifactorial numerical rating scale (NRS) by Pritchett et al. (2003) has not been subjected to inter-observer reliability assessment.

In a previous study (van Loon et al., 2010) the CPS described by Bussières et al. (2008) was used to assess pain in a cross-section of horses in a referral centre. This pain scale, although developed for equine orthopaedic pain, contains various elements that can equally be applied to visceral pain. The data from that preliminary study (van Loon et al., 2010) suggested that the CPS could be of potential use for pain evaluation of horses in intensive care after gastrointestinal (colic) surgery. If this were so, one pain scale could be used both for orthopaedic and postoperative visceral pain assessment. Furthermore, the CPS was assessed in healthy pain-free animals to assess the specificity of the scale and in horses after general anaesthesia to assess possible influences of anaesthesia.

The aim of the current study was to further investigate inter-observer reliability, sensitivity, specificity and clinical applicability of the CPS for pain assessment and related to survival in a larger group of horses suffering from postsurgical gastrointestinal pain. For reasons of comparison, pain was simultaneously scored by means of the composite NRS scale (Pritchett et al., 2003).

Materials and methods

Animals and analgesic treatment

The study design was approved by the institutional Ethics Committee on the Care and Use of Experimental Animals in compliance with Dutch legislation on animal experimentation and individual horse owner's consent was obtained for all horses and ponies participating in this study.

Forty-eight colic cases that had been admitted for emergency laparotomy to the Equine Referral Centre between September 2010 and July 2011, and were subsequently hospitalised in the intensive care unit (ICU) (Table 1), were observed. The study population consisted of 22 mares, 21 geldings and five stallions. Foals and mares with foals were excluded from the study, because of possible effects of mare–foal interaction on the assessment of pain scores. Breeds included Warmbloods (30), Friesians (two), Irish Cobs (two), Fjords (two), Haflingers (two), Standardbred (one) and ponies (nine). Standardised analgesic treatment protocol consisted of non-steroidal anti-inflammatory drugs IV (flunixin, Bedozane, Eurovet; 1.1 mg/kg IV once or twice daily), combined with lidocaine (Lidocaine 20%, University Pharmacy) constant rate infusions (CRI; 50 μg/kg/min IV with loading dose of 1.3 mg/kg IV) for all small intestinal and large intestinal strangulating problems.

Additional analgesic treatment was administered to effect at the discretion of the attending veterinarian and was independent of composite pain scores. Pain assessment was independent of analgesic treatment and the observers were not involved with day-to-day care of the horses and were therefore not aware of the analgesic treatments.

Table 1
Data of horses presenting with colic that had been admitted for emergency laparotomy ($n = 48$) included in the study, comparing survivors and non-survivors.

	Survivors	Non-survivors
Number of horses	39	9
Small intestinal lesion	19[a]	7
Strangulating lesion	11	6
Non-strangulating lesion	8	1
Large intestinal lesion	21[a]	2
Strangulating lesion	3	0
Non-strangulating lesion	18	2
Mean (±SD) weight (kg)	526 (120)	568 (79)
Mean (±SD) age (years)	12 (7)	14 (5)

[a] One horse had both small and large intestines involved. Non-survivors are horses that developed complications after surgery and were euthanased or had re-laparotomy.

For evaluation of composite pain scores over time, horses were categorised according to outcome (survivors versus non-survivors) and the effects of breed and location and type of intestinal lesion on outcome and composite pain scores were assessed.

Composite pain scale (CPS)

The CPS (Bussières et al., 2008) is a multifactorial numerical rating scale based on 13 parameters, including physiologic parameters, responses to stimuli, and spontaneous behavioural parameters (Table 2). Total pain scores range from zero (no signs of pain) to 39 (maximal pain score). To compare clinical usefulness and reproducibility of the CPS with another pain scoring system, we concurrently determined composite pain scores using the multifactorial NRS (Pritchett et al., 2003). The NRS contains nine behavioural categories and total pain scores range from 9 (no signs of pain) to 36 (maximal pain score) (Table 3). Pain scoring was performed with the animals in their box stalls.

Experimental design

Due to practical constraints, observations were performed by five different observers, which is representative of the working situation in a large clinic. CPS and NRS scores were given by the same observer for each individual horse and all observers assessed equal parts of the study population. This was deemed justifiable given the very high inter-observer reliability (Spearman correlation coefficient 0.92, weighted kappa correlation 0.81, $P < 0.001$) determined earlier (van Loon et al., 2010). Prior to commencement of the study, all observers were able to familiarise themselves with the parameters that were assessed in the CPS and NRS using pain-free horses. The observers were not blinded for the clinical diagnosis.

Horses were evaluated every 4 h for 3 days following colic surgery. The first pain scores were not performed earlier than 4 h after recovery to exclude effects of anaesthetics on composite pain scores (van Loon et al., 2010). To determine inter-observer variability, 10 randomly chosen horses were also scored at 40 time points by a second observer. Pain scoring by the second observer was done independently but at similar time points (within 10 min) as the first observer. The observers did not discuss their findings.

Data processing and statistical analysis

All data are expressed as medians and quartiles. Median area under the curve (AUC) values were calculated and differences in CPS scores between groups of horses were analysed using the Mann Whitney U test. Inter-observer reliability was assessed using Spearman's correlation coefficients (r) and weighted kappa coefficients (κ). Bland–Altman plots were used to visually evaluate correlations and determine limits of agreement (average difference ± 1.96 standard deviation of the difference) were calculated (Bland and Altman, 1986; Myles, 2007). Correlations between different individual CPS variables and total CPS scores were assessed using 261 CPS evaluations from 17 randomly selected animals. Statistical analysis was performed using SPSS version 20.0 (SPSS). Statistical significance was accepted at $P < 0.05$.

Results

Inter-observer reliability

CPS scores of two simultaneously scoring independent observers showed significant correlation. ($r = 0.87$, $\kappa = 0.84$, $P < 0.001$) (Fig. 1). Limits of agreement for CPS scores of two independent observers were between −3.3 and +3.1 and the bias between two observers (average discrepancy) was nearly zero. The NRS scoring system also had a significant, but lower inter-observer reliability ($r = 0.68$, $\kappa = 0.72$, $P < 0.001$) and wider ranges for the limits of agreement (between −4.4 and +6.6) with a bias between the two observers of 1.0.

CPS and NRS scores over time for survivors and non-survivors

Median CPS and NRS scores of horses that survived the ICU period showed a different pattern during the entire period, compared to horses that developed complications and did not survive (Fig. 2). The median AUC of the non-survivors was significantly higher than the median AUC of survivors ($P < 0.001$), both for CPS and NRS scores.

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