The Veterinary Journal 206 (2015) 356–364

Contents lists available at ScienceDirect

The Veterinary Journal

journal homepage: www.elsevier.com/locate/tvjl

Monitoring acute equine visceral pain with the Equine Utrecht University Scale for Composite Pain Assessment (EQUUS-COMPASS) and the Equine Utrecht University Scale for Facial Assessment of Pain (EQUUS-FAP): A scale-construction study

Johannes P.A.M. van Loon [a,*], Machteld C. Van Dierendonck [a,b,c]

[a] Department of Equine Sciences, Faculty of Veterinary Medicine, Utrecht University, Yalelaan 114, NL-3584 CM Utrecht, The Netherlands
[b] Veterinary Faculty Ghent University, Salisburylaan 133, 9820 Merelbeke, Ghent, Belgium
[c] Equus Research and Therapy, Tolnegenweg 39, 3776PT Stroe, The Netherlands

ARTICLE INFO

Article history:
Accepted 20 August 2015

Keywords:
Colic
Equine
Pain scale
Facial expression
EQUUS-COMPASS
EQUUS-FAP

ABSTRACT

Although recognition of equine pain has been studied extensively over the past decades there is still need for improvement in objective identification of pain in horses with acute colic. This study describes scale construction and clinical applicability of the Equine Utrecht University Scale for Composite Pain Assessment (EQUUS-COMPASS) and the Equine Utrecht University Scale for Facial Assessment of Pain (EQUUS-FAP) in horses with acute colic. A cohort follow-up study was performed using 50 adult horses ($n = 25$ with acute colic, $n = 25$ controls). Composite pain scores were assessed by direct observations, Visual Analog Scale (VAS) scores were assessed from video clips. Colic patients were assessed at arrival, and on the first and second mornings after arrival. Both the EQUUS-COMPASS and EQUUS-FAP scores showed high inter-observer reliability (ICC = 0.98 for EQUUS-COMPASS, ICC = 0.93 for EQUUS-FAP, $P < 0.001$), while a moderate inter-observer reliability for the VAS scores was found (ICC = 0.63, $P < 0.001$). The cut-off value for differentiation between healthy and colic horses for the EQUUS-COMPASS was 5, and for differentiation between conservatively treated and surgically treated or euthanased patients it was 11. For the EQUUS-FAP, cut-off values were 4 and 6, respectively.

Internal sensitivity and specificity were good for both EQUUS-COMPASS (sensitivity 95.8%, specificity 84.0%) and EQUUS-FAP (sensitivity 87.5%, specificity 88.0%). The use of the EQUUS-COMPASS and EQUUS-FAP enabled repeated and objective scoring of pain in horses with acute colic. A follow-up study with new patients and control animals will be performed to further validate the constructed scales that are described in this study.

Introduction

Animal pain and its recognition and management have received abundant attention over the past decades. Various studies describing tools for objective assessment of pain in farm animals (Prunier et al., 2013), companion animals (Hellyer, 2002; Hansen, 2003) and horses (Wagner, 2010) have laid the basis for the development of improved methods for objective pain assessment, which in turn have contributed positively to animal welfare (Valverde and Gunkel, 2005). Apart from species differences, pain expression is also dependent on the type and origin of pain. Somatic pain and visceral pain, for instance, are different phenomena that manifest differently and need to be treated differently (Robertson, 2002). Colic is one of the most important and often diagnosed diseases in the horse and the availability of purpose built, specific and validated pain assessment tools would help identify colic related pain and therefore add significantly to equine welfare and support quality of patient care.

Simple one-dimensional pain scales like the VAS (Visual Analog Scale) are very commonly used, but are deemed suboptimal instruments for pain evaluation in animals, partly because of poor inter-observer reliability (Lindegaard et al., 2010). Composite pain scales (CPS) offer the advantage that combining various indicators increases sensitivity and specificity of pain assessment (Abbott et al., 1995; Dobromylskyj et al., 2000; Prunier et al., 2013). In humans, multidimensional pain scales have been developed for recurrent abdominal pain in children (Malaty et al., 2005) and assessment of infant pain (Cong et al., 2013). Such pain scales have been described for different types of pain in horses like acute orthopaedic pain (Bussières et al., 2008) and pain after colic surgery (Pritchett

* Corresponding author. Tel.: +31 30 253 1111.
E-mail address: j.p.a.m.vanloon@uu.nl (J.P.A.M. van Loon).

http://dx.doi.org/10.1016/j.tvjl.2015.08.023
1090-0233/

et al., 2003; Graubner et al., 2011; van Loon et al., 2014). Recently, a behaviour-based pain scale for horses with acute colic has been described and validated (Sutton et al., 2013a, 2013b).

Another strategy to assess objectively the amount of pain in an individual is to quantify facial expression. This technique has been studied in humans (Ahola Kohut et al., 2012) and rodents (Sotocinal et al., 2011) and has led to the development of grimace scales for the latter species. Recently, the Horse Grimace Scale (HGS) following surgical castration has been described (Dalla Costa et al., 2014) and the Equine Pain Face has been described after induced experimental pain (Gleerup et al., 2014).

In previous studies, the CPS as described by Bussières et al. (2008) was used to assess pain in a cross-section of equine patients in a referral centre (van Loon et al., 2010) and after emergency laparotomy and treatment in an intensive care unit (van Loon et al., 2014). This pain scale, although originally developed for orthopaedic pain, contains various elements that can also be applied to visceral pain (van Loon et al., 2014). In the current study, the CPS was used as the basis for the development of the Equine University Utrecht Scale for Composite Pain Assessment (EQUUS-COMPASS), a scale aiming at the optimal assessment of acute colic pain. Furthermore, a composite facial expression pain scale was constructed, the Equine University Utrecht Scale for Facial Assessment of Pain (EQUUS-FAP), based on several facial expression characteristics.

The aims of the current study were (1) to assess inter-observer variability of the EQUUS-COMPASS and the EQUUS-FAP; (2) to determine cut-off points for determination between healthy and painful animals; and (3) to assess the clinical applicability for the identification and follow-up of pain in horses with acute colic. The hypotheses were that EQUUS-COMPASS and EQUUS-FAP would have better inter-observer reliability than a VAS scale, would be easily clinically applicable and would be able to differentiate between control horses and colic patients.

Materials and methods

Animals

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. Because the procedures used in this study only contain behavioural observations and physiological assessments (heart rate, breathing rate, borborygmi, rectal temperature) taken from clinical patients and therefore are not likely to cause pain, suffering or distress or lasting harm equivalent to, or higher than, that caused by the introduction of a needle (article 1.5f EU directive 2010/63/EU), ethical approval was obtained without an official approval number. Furthermore, owner's consent was obtained for all horses and ponies participating in this study.

Twenty-five horses that had been admitted to the equine referral centre with acute colic were included (Table 1). Twenty-five control horses (healthy mares that were used as recipients for embryo transfer and horses that came in for regular shoeing) that were admitted in the same period were included as well (Table 1). All control horses were free from lameness and/or teeth problems.

The total study population consisted of 30 mares and 20 geldings. Stallions, foals and mares with foals were excluded from the study because of possibly disturbing effects of sexual arousal or mare–foal interaction on the assessment of pain scores. Breeds included Warmbloods (37), Thoroughbreds (crossbreeds) (3), Friesians (5), Irish Cob (1), Fjorden horse (1), Haflinger (1), Icelandic (1) and Quarterhorse (1). Analgesic treatment and clinical decision-making were at the discretion of the attending veterinarian and independent of pain scores. The observers were not involved with day-to-day patient care and were unaware of any analgesic treatment. All colic patients were given non-steroidal anti-inflammatory drugs (NSAIDs) before referral to the university clinic. If α_2-agonists were required after arrival at the clinic, the horses were excluded from the study because of possible interference with pain scores.

Table 1
Data of horses that were included in the study ($n = 50$).

	Colic	Control
Number of horses	25	25
Conservative treatment (CT)	15	–
Surgical treatment/euthanasia (STE)	5/5	–
Warmblood/Thoroughbred	17	23
Other breeds	8	2
Mean (±SD) weight (kg)	540 (71.8)	593 (37.6)
Mean (±SD) age (years)	11 (6.4)	9 (4.3)

Equine Utrecht University Scale for Composite Pain Assessment (EQUUS-COMPASS)

The EQUUS-COMPASS is based on the CPS described by Bussières et al. (2008). For the development of EQUUS-COMPASS, the CPS was modified by deleting parameters that are not possible to assess in horses with acute abdominal pain (e.g. appetite) and by adding parameters that are thought to be more specific for visceral pain (such as tail flicking, laying down and sounds produced as an expression of pain like teeth grinding or moaning). The EQUUS-COMPASS is a multifactorial simple descriptive scale (SDS) based on 14 parameters. It includes physiological parameters, responses to stimuli, and spontaneous behavioural parameters (Table 2). Each of the 14 parameters can be scored from 0 to 3, leading to a total pain score range from 0 (no signs of pain) to 42 (maximal pain score).

Equine Utrecht University Scale for Facial Assessment of Pain (EQUUS-FAP)

The EQUUS-FAP is a multifactorial SDS based on nine parameters, describing different elements of facial expression, like appearance of eyelids, nostrils and muscle tone (Table 3). Each of the nine parameters can be scored from 0 to 2, leading to a total pain score ranging from 0 (no signs of pain) to 18 (maximal pain score).

Experimental design

Observations were performed by four observers (veterinary students) who performed their observations pairwise and simultaneously. The observers did not discuss their findings. Prior to commencement of the study, all observers were given the chance to familiarize and train themselves with the parameters in the EQUUS-COMPASS and EQUUS-FAP using pain-free horses (not included in the study). The observers were not blinded for the clinical diagnosis.

Patients were evaluated shortly after admission to the university hospital (T0) when horse owners were registered to the patient database, the first morning after admission (T12-24) and the second morning after admission (T36-48). Each observation period lasted 10 min. Scoring was performed with the animals in the colic box, where a video camera recorded the box during scoring. These videos were used to obtain Visual Analog Scores (VAS) on a continuous scale between 0 and 10 (Hawker et al., 2011), performed by two observers (equine veterinarians not involved in the treatment and blinded for time and treatment). The control horses were observed in the same colic box and EQUUS-COMPASS and EQUUS-FAP scores were obtained once, with simultaneous video recordings for VAS scores.

Data processing and statistical analysis

All data are expressed as medians and quartiles. Inter-observer reliability was assessed using Intraclass Correlation Coefficients (ICC). Bland–Altman plots were used to visually evaluate correlations and determine limits of agreement (average difference ± 1.96 standard deviation of the difference) (Bland and Altman, 1986; Myles, 2007). Differences in scores between control animals and colic patients and between conservatively treated animals (CT) and surgically treated or euthanized animals (STE) were analyzed using the Mann–Whitney *U* test. Cut-off values for EQUUS-COMPASS, EQUUS-FAP and VAS were determined to obtain maximal differentiation between colic patients and healthy animals and between CT and STE treatments. Internal sensitivity, specificity, and positive and negative predictive values were determined for EQUUS-COMPASS, EQUUS-FAP and VAS scores using these cut-off values. Sensitivity and specificity for individual parameters of both scores were also determined. Based on these values, weighting factors for future validation for the different individual parameters were determined retrospectively. When sensitivity or specificity was ≤25%, a weighting factor of 0 was applied; between 25% and 50% the weighting factor was 1; between 50% and 75% the weighting factor was 2; and when both sensitivity and specificity were ≥75% a weighting factor of 3 was applied. The effects over time for both EQUUS-COMPASS and EQUUS-FAP scores in colic patients were assessed by means of the Friedman test. Statistical analysis was performed using SPSS version 20.0 (IBM). Statistical significance was accepted at $P < 0.05$.

Results

Inter-observer reliability

Fig. 1 shows the results of correlation analysis between the different pain scores of two independent observers. Both the EQUUS-COMPASS and EQUUS-FAP scores showed strong and significant correlation (ICC = 0.98, $P < 0.001$ for EQUUS-COMPASS scores,