Short Communication

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 validation study

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ABSTRACT

This study presents the validation of two recently described pain scales, 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 follow-up cohort study of 46 adult horses (n = 23 with acute colic; n = 23 healthy control horses) was performed for validation and refinement of the constructed scales. Both pain scales showed statistically significant differences between horses with colic and healthy control horses, and between horses with colic that could be treated conservatively and those that required surgical treatment or were euthanased. Sensitivity and specificity were good for both EQUUS-COMPASS (87% and 71%, respectively) and EQUUS-FAP (77% and 100%, respectively) and were not substantially influenced by applying weighting factors to the individual parameters.

Colic is one of the most important causes of morbidity and mortality in horses (Freeman and Curtis, 2015). Colic-related pain is therefore significant to equine welfare; custom-designed, specific and validated pain assessment tools could improve quality of equine patient care and welfare. Objective and reproducible pain assessment can be performed using several instruments. In recently published literature, composite pain scales have been described for various types of pain (Ashley et al., 2005; Bussières et al., 2008; de Grauw and van Loon, 2015). Furthermore, facial expression has been used to assess the presence and severity of pain, both in humans (Simon et al., 2008) and in horses (Dalla Costa et al., 2014; Gleerup et al., 2014). In a previous study, we described the construction of two composite pain scales: the Equine Utrecht University Scale for Composite Pain Assessment (EQUUS-COMPASS) and the Equine Utrecht University Scale for Facial Assessment of Pain (EQUUS-FAP), to assess pain in horses with acute colic using physiological, behavioural and interactive parameters (EQUUS-COMPASS) and parameters related to facial expression (EQUUS-FAP; van Loon and VanDierendonck, 2015). The aim of the current study was to assess the validity of these scales and to determine their specificity and sensitivity by applying them to a new cohort of colic patients and new cohort of healthy control horses and scored by new observers.

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 consisted only of behavioural observations and physiologic assessments (measurement of heart rate, respiratory rate and rectal temperature, and auscultation for borborygmi) that are routinely performed in clinical settings and are deemed 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 granted without a formal application and hence no official approval number was given. Written consent was obtained from all horse owners for all horses participating in this study.

Twenty-three horses that had been admitted to the equine referral centre with acute colic between May and September 2015 were enrolled (Table 1). Twenty-three control horses (healthy mares that were used as recipients for embryo transfer and horses that were admitted for routine shoeing; all free from lameness and/or dental problems) admitted in the same period were also enrolled (Table 1). All enrolled horses with colic had been referred by an equine practitioner and had been treated before transport with non-steroidal anti-inflammatory drugs. Horses that had been treated with...
analgesics that possibly could interfere with their mental state (α2-agonists and opioids) were excluded from the study.

Both EQUUS-COMPASS and EQUUS-FAP have been described and internally validated in a previous study (van Loon and VanDierendonck, 2015). Details of score sheets are provided in Supplementary Tables S1 and S2. For the current validation study, scoring was performed and presented in exactly the same manner.

All pain scoring data are expressed as medians and quartiles and were considered non-normally distributed. Differences between age and weight were statistically tested using independent t-tests. Differences in pain scores between control horses and horses with colic and between conservatively treated horses (CT) and surgically treated or euthanased horses (STE) were analysed using Mann Whitney U tests. Cut-off values for EQUUS-COMPASS and EQUUS-FAP to obtain maximal differentiation between horses with colic and healthy horses and between CT and STE treatments and weighting factors for various individual parameters were applied as described earlier (van Loon and VanDierendonck, 2015). Sensitivity, specificity, and positive and negative predictive values were determined using these cut-off values and weighting factors. Removing physiological parameters from the EQUUS-COMPASS would make this scale suitable for horse owners; applying weighting factors could hypothetically improve sensitivity and specificity. Effects over time for both EQUUS-COMPASS and EQUUS-FAP scores in conservatively treated horses with colic were assessed by Friedman tests. Statistical analysis was performed using commercially available software (SPSS version 20.0, IBM). Statistical significance was accepted at \( P < 0.05 \).

Control horses and those with colic had significantly different EQUUS-COMPASS and EQUUS-FAP scores (\( P < 0.01 \), as did horses in the CT group and those in the STE group (EQUUS-COMPASS, \( P < 0.01 \); EQUUS-FAP, \( P < 0.05 \); Fig. 1). Fig. 2 shows EQUUS-COMPASS and EQUUS-FAP scores over time for horses in the CT group (\( n = 17 \)). Both pain scores decreased significantly over time (\( P < 0.01 \)).

Tables 2–4 show sensitivity, specificity, positive and negative predictive values for EQUUS-COMPASS and EQUUS-FAP both before and after applying weighting factors and eliminating of physiological parameters. Contrary to our hypothesis, the application of weighting factors did not improve sensitivity and specificity. However, a version of the EQUUS-COMPASS score that did not include physiological parameters but did apply weighting factors to the remaining parameters produced similar results to the extended version with or without weighting factors.

Our study validated and refined the EQUUS-COMPASS and EQUUS-FAP, a composite pain scale and a facial expression pain scale, respectively, which were constructed for valid and reliable assessment of the severity in horses with acute colic. The results from our previous scale construction study were confirmed in a dataset of new horses in the current study. In a study by Taffarel et al. (2015), refinement of a composite pain scale to assess postoperative pain in horses was performed by selecting on highest relevance, specificity and total item-correlation. In this validation study, we refined both pain scales by eliminating physiological parameters from the scale and applying weighting factors. The need for the inclusion of physiological parameters has been questioned (Sutton et al., 2013).

In our study, the exclusion of physiological parameters and the application of weighting factors to the remaining parameters led to comparable results for sensitivity and specificity, suggesting that horse owners could use the shortened version of the COMPASS score.

### Table 1

<table>
<thead>
<tr>
<th></th>
<th>Colic</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of horses</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>Conservative treatment (CT)</td>
<td>17</td>
<td>–</td>
</tr>
<tr>
<td>Surgical treatment/euthanasia (STE)</td>
<td>6</td>
<td>–</td>
</tr>
<tr>
<td>Warmblood/Thoroughbred</td>
<td>13</td>
<td>19</td>
</tr>
<tr>
<td>Other breeds</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Mean (±SD) weight (kg)</td>
<td>482.1 (153.1)</td>
<td>503.3 (93.3)</td>
</tr>
<tr>
<td>Mean (±SD) age (years)</td>
<td>10.1 (5.6)</td>
<td>8.8 (3.9)</td>
</tr>
</tbody>
</table>

* Weight and age were not statistically different between horses with colic and control horses (\( P = 0.72 \) and 0.33, respectively).
without the need to interpret physiological parameters such as heart and respiratory rates.

The results of the previous scale construction study and the current validation study demonstrate that both EQUUS-COMPASS and EQUUS-FAP scores can be used for reliable and reproducible pain assessment in horses with acute colic. The EQUUS-FAP and the weighted EQUUS-COMPASS without physiological variables is suitable for use by both veterinarians and horse owners.

Conflict of interest statement

This study was partly funded by Boehringer Ingelheim BV, Alkmaar, The Netherlands. The funding source was not involved in the study design, execution, data collection, statistical analysis or interpretation of the data from this study, or in writing of the manuscript. None of the authors of this paper has any other financial or personal relationship with people or organisations that could inappropriately influence or bias the content of the paper.

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Appendix: Supplementary material

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.tvjl.2016.08.004.

Table 3
Sensitivity and specificity of weighted EQUUS-COMPASS and EQUUS-FAP.

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
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</thead>
<tbody>
<tr>
<td>Colic (n = 23) vs. control (n = 23)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EQUUS-COMPASS</td>
<td>87%</td>
<td>71%</td>
</tr>
<tr>
<td>EQUUS-FAP</td>
<td>59%</td>
<td>95%</td>
</tr>
<tr>
<td>CT (n = 17) vs. STE (n = 6)</td>
<td>100%</td>
<td>76%</td>
</tr>
<tr>
<td>EQUUS-COMPASS</td>
<td>67%</td>
<td>94%</td>
</tr>
<tr>
<td>EQUUS-FAP</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

EQUUS-COMPASS, Equine University Utrecht Scale for Composite Pain Assessment; EQUUS-FAP, Equine University Utrecht Scale for Facial Assessment of Pain.

Table 4
Sensitivity and specificity of EQUUS-COMPASS without physiological parameters, before and after applying weighting factors for individual parameters.

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colic (n = 23) vs. control (n = 23)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EQUUS-COMPASS without weighting factors</td>
<td>83%</td>
<td>67%</td>
</tr>
<tr>
<td>EQUUS-COMPASS with weighting factors</td>
<td>83%</td>
<td>76%</td>
</tr>
</tbody>
</table>

EQUUS-COMPASS, Equine University Utrecht Scale for Composite Pain Assessment; EQUUS-FAP, Equine University Utrecht Scale for Facial Assessment of Pain.

References


