RESEARCH ARTICLE

Clinical Assessment of Pain in Horses with Colic using Composite Pain Scale and Horse Grimace Scale

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Abstract

The current study evaluated two pain assessment measures in horses with colic: (1) the Composite Pain Scale (CPS), which assesses overall clinical (behavioural and physiological) pain, and (2) the Horse Grimace Scale (HGS), which examines changes in pain-related facial expressions. A total of 30 horses with a clinical diagnosis (based on clinical signs) of colic were tested over four days of treatment. Pain evaluation was used to divide colic in horses into mild, moderate and severe pain groups according to severity. The control group consisted of eight clinically and apparently healthy horses. CPS scores differed significantly between pain groups ($p < 0.01$), with horses experiencing severe pain having the highest score, followed by moderate and mild pain. HGS scores were considerably higher ($p < 0.01$) in horses experiencing moderate to severe pain. Both pain scores in colic-affected horses decreased gradually throughout the therapy period. These findings imply that the CPS is an effective and objective tool for assessing and monitoring the degree of acute pain associated with equine colic. The HGS may provide further information on pain-related facial (expression) changes and can complement clinical pain assessment. These measures may support veterinarians in assessing pain severity, monitoring changes during treatment and improving pain management in horses with colic.

Key words: Composite pain scale, Equine colic, Horse grimace scale, Pain in horses, Pain scale.

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Introduction

Colic is one of the most significant clinical emergencies in horses and is primarily manifested by abdominal pain that can range from mild, transient discomfort to severe and life-threatening pain. Pain assessment in horses remains challenging since pain is a subjective sensation that cannot be verbally articulated, and its behavioural presentation varies between individuals and is influenced by temperament, environment, and illness stage. Consequently, no universally accepted gold-standard approach for the objective of equine pain exists, and traditional visual analogue or numerical rating scales may be influenced by observer interpretation and inter-observer variability (Ashley *et al*., 2005; de Grauw and van Loon, 2016). Accurate pain severity assessment is clinically important because it contributes to evaluation of the horse's clinical status, monitoring of disease progression, assessment of treatment response and decisions regarding medical or surgical management (Ashley *et al*., 2005; Sutton *et al*., 2013a,b). These constraints have prompted the development of structured, reproducible and clinically applicable pain-assessment tools. Composite Pain Scales (CPS) present a multidimensional approach by integrating physiological and behavioural variables into a single numerical score. Such scales can facilitate repeated assessment of pain and have shown good reproducibility in horses with somatic and visceral pain (Bussieres *et al*., 2008; van Loon *et al*., 2010).

However, physiological variables such as heart rate and respiration rate are not specific to pain and can be altered by fear, excitement, disease condition, shock, endotoxaemia or medication; therefore, behavioural assessment remains a crucial component of pain evaluation (Ashley *et al*., 2005; de Grauw and van Loon, 2016). Behaviour-based assessment is especially important in horses with acute colic because characteristic behaviours can reflect the severity of abdominal pain. Facial expressions have emerged as an additional indicator of pain in horses. Pain-related facial changes include altered ear position,

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orbital tightening, tension above the eyes, changes in the mouth and masticatory muscles and increased facial and nostril tension (Dalla Costa *et al*., 2014). Facial-expression assessment may therefore complement the systemic behavioural and physiological data collected through composite pain scoring.

The application of complementary pain-assessment methods is especially important in horses with colic because abdominal pain may change significantly with illness progression and therapy. Previous clinical research has demonstrated that both CPS and HGS can provide reliable pain measurements in colic patients, with excellent inter-observer reliability found for both scales, indicating their potential clinical utility (Rosenzweig *et al*., 2021). Therefore, a combined assessment may provide a more comprehensive and objective description of pain than relying on clinical signs or one indication. The purpose of this study was to clinically assess pain in horses affected with colic using the Composite Pain Scale (CPS) and Horse Grimace Scale (HGS) to compare pain scores among different pain-severity categories and to analyse changes in pain scores over four-day treatment. This approach was intended to provide clinically meaningful information for objective assessment of pain severity and treatment response in horses with colic.

Materials and Methods

The current study focused on naturally occurring clinical cases presented to the Veterinary Clinical Complex, College of Veterinary Science and Animal Husbandry, Kamdhenu University, Sardarkrushinagar. As the study involved routine clinical evaluation and management of spontaneously occurring cases with no experimental intervention, separate approval from the Institutional Animal Ethics Committee (IAEC) was not necessary.

Animal/Case Inclusion Criteria

Throughout the 19-month study period, 476 horses of various ages, breeds, and sexes were presented to the Veterinary Clinical Complex for colic screening. The study comprised 30 horses with a clinical diagnosis of colic based on clinical examination (Radostits *et al*., 2007), as well as eight clinically healthy horses with no indication of abdominal pain as control groups. Pain severity was determined using the Composite Pain Scale (CPS) described by Bussieres *et al*. (2008) and the Horse Grimace Scale (HGS) developed by Dalla Costa *et al*. (2014). The CPS incorporates physiological and behavioural parameters to provide a composite pain score, whereas the HGS accesses distinctive facial expressions associated with pain. CPS and HGS scores were recorded as numerical values at each assessment period for descriptive and comparative evaluation. The scores were further classified based on severity, mild, moderate, and severe categories, using predetermined, study-specific criteria. Accordingly, CPS scores in the range of 0-10, 11-20, and 21-31 were classified as mild, moderate, and severe pain, respectively, whereas HGS scores of 0, 1-6, and 7-12 were classified as mild, moderate, and severe pain, respectively. These categories were only utilized in the current investigation to facilitate comparison between the two pain scale (CPS and HGS) methods, and they were not considered as a universal validated clinical cut-off range for CPS or HGS.

Statistical Analysis

Data collected on CPS and HGS during the study period was evaluated using the analysis of variance procedure of SPSS software (Snedecor and Cochran, 1994) to compare pain scores among the predefined pain-severity categories and observation periods. Spearman's rank correlation coefficient was used to assess the relationship between CPS and HGS scores across the three pain-severity categories.

Results and Discussion

The current study aimed to evaluate the clinical utility of the Composite Pain Scale (CPS) and Horse Grimace Scale (HGS) for objective assessment of pain severity in horses with colic as well as to determine their association and comparative applicability in clinical settings.

Composite Pain Scale (CPS)

The Composite Pain Scale (CPS) ratings in all three colic severity groups decreased considerably from day one to day four (Table 1), indicating that pain status improves gradually with therapeutic care. The consistently higher ratings in the severe group, followed by the moderate and mild groups, demonstrate that CPS was able to differentiate the degree of clinically expressed pain. The progressive decline in scores over successive treatment days further indicates its usefulness for serial monitoring of pain and response to treatment. The multimodal aspect of CPS, which combines behavioural and physiological indicators, is advantageous because pain in horses cannot be reliably characterised by a single clinical measure. Bussieres *et al*. (2008) discovered good inter- and intra-observer reproducibility of CPS and identified response to palpation of the painful area, posture, pawing, kicking at the abdomen, and head movement as key behavioural indicators of pain.

The findings of the current study are consistent with the observations reported by de Grauw and Van Loon (2016), who stated that composite pain scales provide a structured approach for objective assessment and longitudinal monitoring of pain in horses. Their review also highlighted that the utility of a pain scale changes depending on

Table 1: Composite pain scale (CPS) scores in horses with different severities of colic during the treatment period

Severity	Day-1	Day-2	Day-3	Day-4	Sig.
Mild	9.87±0.12^{d}	7.50±0.62^{c}	2.50±0.32^{b}	0.12±0.12^{a}	0.000
Moderate	16.50±0.77^{d}	12.87±0.54^{c}	7.00±0.73^{b}	2.25±0.31^{a}	0.000
Severe	24.62±0.56^{d}	19.87±0.76^{c}	12.37±0.49^{b}	3.00±0.32^{a}	0.000

Means bearing different superscript letters within a row differ significantly at $p < 0.001$.

the type of painful condition and that validation in one pain model cannot be immediately applied to another. This is crucial for the current study since the original CPS was created and validated mostly in horses with acute orthopaedic pain, whereas the current study focuses on naturally occurring visceral pain associated with colic (Vinuela-Fernandez *et al*., 2011). As a result, rather than reflecting a thorough re-validation of the original scale, the considerable differences between the three colic severity groups, as well as the marked decline in ratings during therapy, provide supporting evidence for the practical usefulness of CPS in equine colic.

The temporal reduction in CPS scores seen in the current study is highly noteworthy from a therapeutic standpoint. An efficient pain assessment approach should not only detect the presence and severity of pain but also detect clinically significant changes throughout therapeutic management. In the present investigation, the highest scores were recorded on Day 1 and subsequently declined on Days 2, 3, and 4 (Table 1), indicating that CPS was responsive to clinical improvement in affected horses. Van Loon *et al.* (2014) reported that CPS scores may distinguish pained horses from controls and can decrease following proper analgesic therapy. Thus, regular CPS assessments may provide veterinarians with an objective tool for assessing pain progression during conservative colic treatment.

Van Loon *et al*. (2014) and Van Loon and Van Dierendonck (2015) concluded that composite and facial-expression-based techniques for monitoring acute equine visceral pain and emphases the necessity of objective pain assessment in horses with colic. This lends credence to the use of a multidimensional measure of CPS in clinical colic cases. However, distinctions between scales designed for orthopaedic and visceral pain should be noted because behavioural expression can vary depending on the underlying source and intensity of pain. Although the current study used predefined severity categories of mild, moderate, and severe pain for comparative analysis, these categories should be regarded as study-specific classifications rather than globally verified clinical cut-off values. De Grauw and Van Loon (2016) reported a comprehensive review that revealed difficulties in the validity and clinical transferability of existing equine pain scales, emphasising the need for future pain scoring system improvement and validation. Overall, the significant differences between the mild, moderate, and severe colic groups, as well as the progressive decline in scores over the four-day observation period, indicate that CPS was useful for differentiating pain severity and monitoring changes in pain status in horses with colic (Table 1). As a result, the absolute CPS score should be considered alongside the overall clinical examination, behavioural changes, physiological findings, and progression of the underlying disease, rather than as an independent criterion for treatment decisions.

Horse Grimace Scale (HGS)

The HGS scores varied significantly between colic severity groups and across the treatment period (Table 2). Horses in the mild colic group had no observable facial pain features throughout the observation period, whereas moderate colic cases showed HGS scores higher on Days 1 and 2 that progressively declined to zero by Day 3. The severe colic group exhibited the highest HGS scores on Day 1, followed by a progressive and significant ($p < 0.01$) decrease on Days 2, 3, and 4. As a result, the HGS was more responsive to the moderate and severe pain states than to the mild colic group and showed a clear temporal relationship to clinical recovery.

The current study's facial changes, particularly backward-directed ears, orbital tightening, tension above the eyes, strained mouth and masticatory muscles, and altered nostril appearance (Fig. 1), correspond with the facial action units described by Dalla Costa *et al*. (2014). The HGS consists of six facial action units, each scored according to its degree of expression and severity of pain, and the total HGS score showed good inter-observer reliability and correlated with composite pain scores. This supports the current finding that facial expression can provide an additional, readily observable indicator of discomfort in horses.

Gleerup and Lindegaard (2016) found significant increases in pain-related facial traits after experimentally inducing acute pain, which supports the severe group's strong HGS reaction. The horse's pain face is distinguished by low or asymmetrical ears, an altered or angled eye appearance, a withdrawn and tense stare, mediolateral nostril dilatation, and tension of the lips, chin, and facial muscles as characteristic components of the equine pain

Table 2: Horse grimace scale (HGS) scores in horses with different severities of colic during the treatment period

Severity	Day-1	Day-2	Day-3	Day-4	Sig.
Mild	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	-
Moderate	3.62±0.18^{c}	2.12±0.29^{b}	0.00±0.00^{a}	0.00±0.00^{a}	0.000
Severe	9.50±0.26^{d}	7.00±0.26^{c}	3.12±0.35^{b}	0.50±0.26^{a}	0.000

Means bearing different superscript letters within a row differ significantly at p < 0.01.



Fig. 1: Different facial expressions assessed using the Horse Grimace Scale (HGS)

face. These findings provide a physiological and behavioural basis for the facial alteration observed in the current colic cases.

An important finding of the current investigation was the absence of a quantifiable score of HGS alternation in horses classified with mild colic. This does not necessarily imply the absence of pain; rather, it suggests that facial expressions may have inadequate sensitivity for identifying low-intensity pain under clinical conditions. As a result, a low or zero HGS score should not be interpreted independently as evidence that a horse is pain-free, especially when other clinical or behavioural indicators suggest discomfort.

The current study's findings on the link between HGS and CPS are clinically important. According to Van Loon *et al*. (2014), who found that greater HGS scores were linked to higher composite pain scores (CPS), supporting the concept that facial expression can complement multidimensional pain assessment. In the current study, horses with more pronounced facial alterations had higher CPS ratings, indicating that the two approaches caught similar features of the pain experience. However, CPS emphasises a wide range of physiological and behavioural attributes, whereas HGS is limited to facial expressions; thus, the two measures should be viewed as complementary rather than interchangeable assessments.

The progressive decline in HGS scores from Day 1 to Day 4 in the moderate and severe groups further indicates that the scale can detect changes associated with clinical improvement after therapeutic management. This is especially useful for colic patients, when pain evaluation must be done on a regular basis to determine therapy response. However, factors other than pain can influence facial expressions. Gleerup *et al*. (2015) emphasised that some facial features identified in the HGS, particularly backward-directed ears and orbital tightening, may occur during fatigue or drowsiness and suggested that facial

Table 3: Spearman rank correlation coefficients of CPS and HGS scores during the four-day observation period

	CPS D1	HGS D1	CPS D2	HGS D2	CPS D3	HGS D3	CPS D4
HGS D1	0.952**	1					
CPS D2	0.962**	0.914**	1				
HGS D2	0.957**	0.973**	0.922**	1			
CPS D3	0.948**	0.927**	0.917**	0.918**	1		
HGS D3	0.817**	0.860**	0.817**	0.915**	0.761**	1	
CPS D4	0.792**	0.776**	0.760**	0.731**	0.780**	0.512*	1
HGS D4	0.470*	0.414*	0.468*	0.438*	0.471*	0.498*	0.240

*p < 0.05, **p < 0.01, and correlations without asterisks were not statistically significant. Note: Values represent Spearman's rank correlation coefficient (*r*).

expression should be interpreted within the overall clinical context. Facial features can be assessed without physical manipulation of the horse, which may be particularly useful in painful or emergency cases where handling can increase stress or potentially aggravate discomfort. At the same time, clinical application may be influenced by head movement, environmental variables, observer posture, and the nuances of face changes.

Overall, the findings presented in Table 2 indicate that the HGS was particularly useful for recognising and monitoring moderate to severe pain associated with equine colic, though its ability to detect mild pain appeared limited in the current study. The considerable reduction in scores during the treatment period supports its usefulness as a simple, non-invasive method for monitoring changes in pain-related facial expression. However, because facial expression alone may not capture all aspects of equine pain, HGS should be interpreted alongside behavioural, physiological, and other validated pain-assessment tools such as CPS. This approach may provide a more comprehensive assessment of pain severity and treatment response in horses with colic.

Correlation between Composite Pain Scale (CPS) and Horse Grimace Scale (HGS)

During the initial phase of clinical assessment, Spearman rank correlation analysis revealed a significant positive link between CPS and HGS (Table 3). On Day 1, CPS showed a substantial correlation with HGS ($r = 0.952$, $p < 0.01$). Similarly, CPS and HGS scores showed strong positive associations on Days 1 and 2, with coefficients ranging from 0.914 to 0.973 ($p < 0.01$). This research reveals that horses with higher CPS scores displayed more significant pain-related facial expressions during the early stages of colic treatment. Dalla Costa *et al*. (2014) discovered a link between facial expression alterations measured using HGS and composite pain scores (CPS) in horses. HGS assesses specific facial action units, whereas CPS considers behavioural and physiological responses; thus, the observed association implies that facial expression can provide additional information for detecting pain in horses.

The strength of the relationship gradually decreased during the later stages of therapeutic management. Significant ($p < 0.01$) correlations were identified for most comparisons up to Day 3; however, coefficients were lower than those obtained during Days 1 and 2. On Day 4, correlations ranged from $r = 0.240$ to 0.498, while the CPS and HGS had no significant correlation ($r = 0.240$). This pattern indicates that the two assessment methods did not alter at the same range throughout clinical recovery. The disparity may be due to the distinct parameters measured by each scale. CPS incorporates several behavioural and physiological responses, whereas HGS specifically evaluates facial features associated with pain. Physiological Variables can be influenced by factors other than pain, including stress, fear, and the general clinical condition of the horse.

The weaker relationship during the later treatment period may also be linked with the significant decrease in HGS scores as clinical improvement occurred. In the current investigation, HGS scores decreased to zero in the moderate pain group by Day 3 and a very low level in the severe pain group by Day 4 (Table 2). Furthermore, facial pain features may vary in strength and frequency throughout a painful episode. Gleerup *et al*. (2015) identified different facial modifications in horses during acute pain and discovered that certain facial features did not remain consistently expressed throughout the painful episode. This may assist to explain that lower correlation between CPS and HGS in the latter phases of clinical recovery. The findings support the use of CPS and HGS as complementary approaches to assessing pain in horses. As a result, combining interpretation with behavioural markers allows for a more complete assessment of pain. Facial expression has the additional advantage of being a rapid and non-invasive method, but its interpretation may be altered by exhaustion, observer engagement, and the horse's overall clinical status.

The current study demonstrated a strong positive relationship between CPS and HGS during the early phase of colic treatment, which gradually decreased with clinical recovery. The findings suggest that HGS can provide

important extra information about pain-related facial expressions, particularly when pain is plainly visible, whereas CPS provides a more comprehensive assessment of the overall pain response. As a result, combining CPS and HGS may give a more comprehensive assessment of pain severity and treatment response in horses with colic. The gradual decline in CPS and HGS scores after treatment indicates the scale's usefulness not only in detecting pain severity but also in monitoring changes in pain status and evaluating clinical response to therapy. Serial assessment using additional pain ratings may therefore provide important information for clinical management and recovery in colic patients.

Conclusion

The current study reveals that both the Composite Pain Scale (CPS) and the Horse Grimace Scale (HGS) are appropriate for assessing clinical pain in horses with colic. The CPS provides a holistic evaluation of pain by combining behavioural and physiological responses, and it proved especially beneficial for detecting changes in pain severity after therapy. The HGS provides a quick, non-invasive assessment of pain-related facial expression and is more useful in horses with moderate-to-severe pain; however, its ability to detect mild pain appeared limited in the current investigation. The progressive decline in both CPS and HGS scores during therapeutic management recognises their effectiveness in monitoring treatment response. As a result, CPS and HGS should be considered complementary rather than interchangeable approaches, with CPS providing a more comprehensive assessment of the overall (behavioural and physiological) pain response and HGS providing additional information from facial expressions. Their combined interpretation with standard clinical examination may allow for a more objective, consistent, and welfare-orientated assessment and management of colic pain in horses.

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