Received: 17 January 2023 | Revised: 20 October 2023 | Accepted: 27 October 2023

DOI: 10.1002/vetr.3615

Vet Record

ORIGINAL RESEARCH

Prospective case study of critical decision making for horses referred for treatment of colic

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University of Nottingham; World Horse Welfare

Abstract

Background: There is limited evidence on factors affecting critical decision making for horses with colic. This study's aim was to describe the assessment and decision making involved in horses referred for management of colic.

Methods: An in-depth case analysis was used to document case presentation, decision making and outcomes for horses referred for colic to two UK equine veterinary practices over a 12-month period. The data recorded included previous history, presenting signs, response to treatment, case outcome and factors affecting decisions for further treatment or euthanasia.

Results: Data were available for 60 cases: 55 were hospitalised for medical or surgical treatment and five horses were euthanased following initial assessment. The main factors affecting treatment decisions were severity of clinical signs (80%, 47/59), financial concerns (10%, 6/59) and ongoing health issues or previous history of colic (5%, 3/59). Factors associated with euthanasia decisions were postoperative complications (5/18), poor prognosis (4/18), deteriorating clinical signs (3/18) and financial concerns (3/18).

Limitation: The limited study population may affect the extent to which the findings can be generalised.

Conclusion: The severity of clinical signs was the key factor in treatment decision making. The main factors affecting euthanasia decisions were clinical deterioration, poor prognosis and financial constraints. These findings should be incorporated into clinical case recording to capture the multifactorial nature of decision making.

INTRODUCTION

'Colic', the collective term used to describe clinical signs of abdominal pain within the horse,[1] accounts for over one-third of emergency out-of-hours calls in first opinion equine practice.[2] Approximately one-fifth of cases may be critical, where horses require hospitalisation for medical or surgical treatment, euthanasia or death.[2,3] These cases require rapid decision making,[4] but there are a multitude of factors that can hinder the decision to refer a horse, such as the horse owner's knowledge and experience[5,6] and the potential for the animal to return to work.[7] Several studies have documented colic mortality due to elective euthanasia,[2,3,8] with Ireland et al.,[8] identifying several owner-related factors that could influence decision making for euthanasia following a diagnosis of colic. However, specific evidence on decision making associated with 'critical cases' of colic (i.e., those that require immediate hospital referral or euthanasia) by both veterinary surgeons and owners is lacking. Therefore, further research into factors affecting decision making during critical cases of colic is required.

Large-scale studies provide invaluable data across whole populations; however, they do not capture the individual journey and influencing factors for each individual horse (such as how an owner's financial situation or the horse's insurance status may affect decisions for surgery or euthanasia). In-depth case analyses are used in human medicine to 'obtain an in-depth appreciation of an issue, event or phenomenon of interest, in its natural real-life context'. They are described as a 'naturalistic' design as opposed to a more traditional 'experimental' design and can

provide a different insight into clinical decision making.

The aim of this study was to describe the assessment and decision-making processes for horses referred for colic management and identify factors that may contribute to death/euthanasia using an in-depth case analysis approach. The objectives of this study were:

- To describe the clinical presentation and diagnostic findings of horses presenting with colic.
- To document the progression of clinical signs and impact of any treatments.
- To explore factors associated with the decision to pursue medical or surgical treatment for colic.
- To identify factors associated with the decision to euthanase a horse referred for colic assessment.

METHODS

Study design

This study used an in-depth case analysis to describe case presentation, clinical findings, treatment, case progression, factors affecting decision making and outcomes for horses referred for colic.

Participant recruitment

A prospective, 12-month study was developed to collect data from veterinary surgeons routinely involved in the clinical assessment of horses presenting with abdominal pain. Equine veterinary establishments that provided both first opinion and referral services to clients were identified as the target population for this study. Three UK veterinary practices that each provided both first opinion and referral hospital services were recruited to participate.

Case selection

Participating practices were asked to report information for all horses referred for colic investigation, regardless of case outcome or severity. Colic was defined as 'any incidence of abdominal pain as assessed by the veterinary surgeon in attendance'.[3] Cases were deemed separate occurrences if a colic-free period of 7 days was noted. Short-term survival (defined as the time from initial veterinary examination to hospital discharge or the conclusion of the primary assessment and/or treatment) was the focus of this study; therefore, follow-up information was not sought.

Development of data collection forms

Bespoke colic assessment forms were developed (Supporting Information S1). The forms comprised eight sections with a mixture of open- and closed-question formats. Form content was based on systems currently used by participating practices and data in existing literature associated with either the development of colic or case outcome (Supporting Information S2).

To maintain consistency, several scoring systems were developed based on existing literature. These were as follows:

- Body condition scoring system[9,10]
- Demeanour score[3,11–13]
- Behaviour severity[3,11,13,14]

Predefined answer options presented in three of the eight sections were created following discussions with three equine veterinary surgeons (two from the research team and one from a participating practice). These category options represented the most frequent diagnostic outcomes and colic diagnoses experienced during a colic assessment, although participants could enter a free-text answer under the 'other' option if necessary.

Section eight of the form collected variables around treatment, case outcome and factors affecting owner decision making. Open text formats were used to allow practitioners to describe the medical and surgical treatment provided in addition to detailing the significant factors in formulating a treatment plan and the decision to opt for euthanasia.

Predefined answer options were used within section eight for further detail of supportive therapy during medical or surgical treatment and short-term survival. The time of sudden death or euthanasia in relation to arrival and treatment provided at the referral hospital were recorded as discrete options.

Paper-based forms were piloted for 2 weeks (July and August 2018) by participating practices. Minor corrections were performed before disseminating the final forms to practices.

Form dissemination

To comply with data protection regulations, horse owner information sheets and study consent forms were created. A personalised 'Research Pack' containing paper-based copies of all study resources was sent to participating practices 1 week prior to study launch. Paper-based forms and resources were used based on the practices' preferred formats. The study was launched at the end of August 2018 and ran until September 2019. A named contact person at each practice received weekly emails reminding participants to submit cases.

Statistical methods

Data were manually entered into an Excel spreadsheet (Microsoft Office 2016, version 16.0) for data cleaning and rechecked for correctness by the primary researcher. Missing data were identified by a

numerical code ('000') during preliminary analysis and subsequently recorded as 'unknown' if practices were unable to supply further information when contacted. Full data sets were not recorded for all assessments, and the number of data points for each assessment is given ($n = x$).

Exploratory descriptive analyses were performed. All continuous data were non-parametrically distributed, and ordinal data were summarised as the median (interquartile range [IQR], range). Frequency percentages and mode values were calculated for categorical data. Descriptive analysis was only performed due to the range of factors affecting decision making and case progression, including qualitative data. Free-text responses were reviewed and categorised using a content analysis approach[15] and ranked based on frequency of occurrence. Cases were grouped according to treatment and outcome (no treatment, medical treatment and survived to discharge, medical treatment and did not survive to discharge, surgical treatment and survived to discharge, surgical treatment and did not survive to discharge, euthanasia or death). The case presentation, diagnostic results and factors affecting decision making were compared iteratively to identify similarities and differences within and between different cases and outcomes and document the decision-making pathways.

RESULTS

Participants

A total of 60 referral colic case assessment forms were collected. Practice B did not submit any cases during the data collection period and was therefore excluded from the study. Practice C submitted the majority (72%, 43/60) of cases, with practice A providing details for 28% (17/60). Most (15%, 9/60) cases were submitted in October 2018, with both practices providing no data in February 2019.

Case outcome

Case outcome was available for 55 (92%) horses (Figure 1). Short-term survival (to discharge) was 67% (37/55) for all horses and 65% (13/20) for those recovering from anaesthesia. A total of 18 horses were euthanased, with five receiving no further treatment on admission. The following results first provide an overview of all cases, with specific details pertaining to euthanased horses presented at the end.

Horse demographics

Signalment

Most horses were geldings (58%, 35/60) and had a median age of 12 years (IQR: 8–16, range: 1–26 years). Twenty-one equine breeds/types were represented, with the most common being Thoroughbred (27%, 16/60) and sports horse (15%, 9/60). Horses were primarily used for general and/or leisure purposes (40%, 24/60), with most being in light (42%, 14/33) or medium (33%, 11/33) work. Seventy percent (39/56) were uninsured. Of those who were insured (30%, 17/56), seven were covered for both mortality and veterinary fees, three only had protection for veterinary fees and seven did not provide policy details.

Previous medical history

Sixty-three percent (37/59) of horses had no ongoing or previous medical issues. Thirty-seven percent (22/59) had at least one current health complaint, with the majority reportedly having gastric ulcers (14%, 3/22), laminitis (14%, 3/22) or respiratory illness (14%, 3/22). Stereotypical behaviour was present in 17% (10/60) of horses, with windsucking most commonly reported (50%, 5/10). Of the cases that provided details for preventative healthcare, most owners did not know or could not remember when their horse was last wormed (72%, 42/58) or received a dental examination (68%, 39/57).

Recent management changes

No changes in routine management (77%, 46/60) or feeding (93%, 56/60) were reported for most horses. Stabling and/or pasture changes occurred in 23% (14/60) of cases, with the most commonly reported change being a recent decrease in turnout (21%, 3/14) or alternative grazing (21%, 3/14). The feeding regimen was changed in four (7%) cases.

Previous history of colic

Ninety-three percent (55/60) of horses had not experienced a colic event within the previous 30 days. Of those that had (7%, 4/59), two horses were attended by a veterinarian 1 day prior to admission, with one horse being examined for colic 6 days previously (all classed as same episode of colic). One horse received two veterinary visits, with the other three requiring only one.

Clinical presentation

Onset of signs versus time first examined versus time of admission

There was a median duration of 10 hours (IQR: 4–13, range: 0–120 hours) before colic signs were first recognised by the horse's owner ($n = 53$). Attempts to lie down (45%, 27/60), pawing at the ground (37%, 22/60) and a depressed and/or dull demeanour

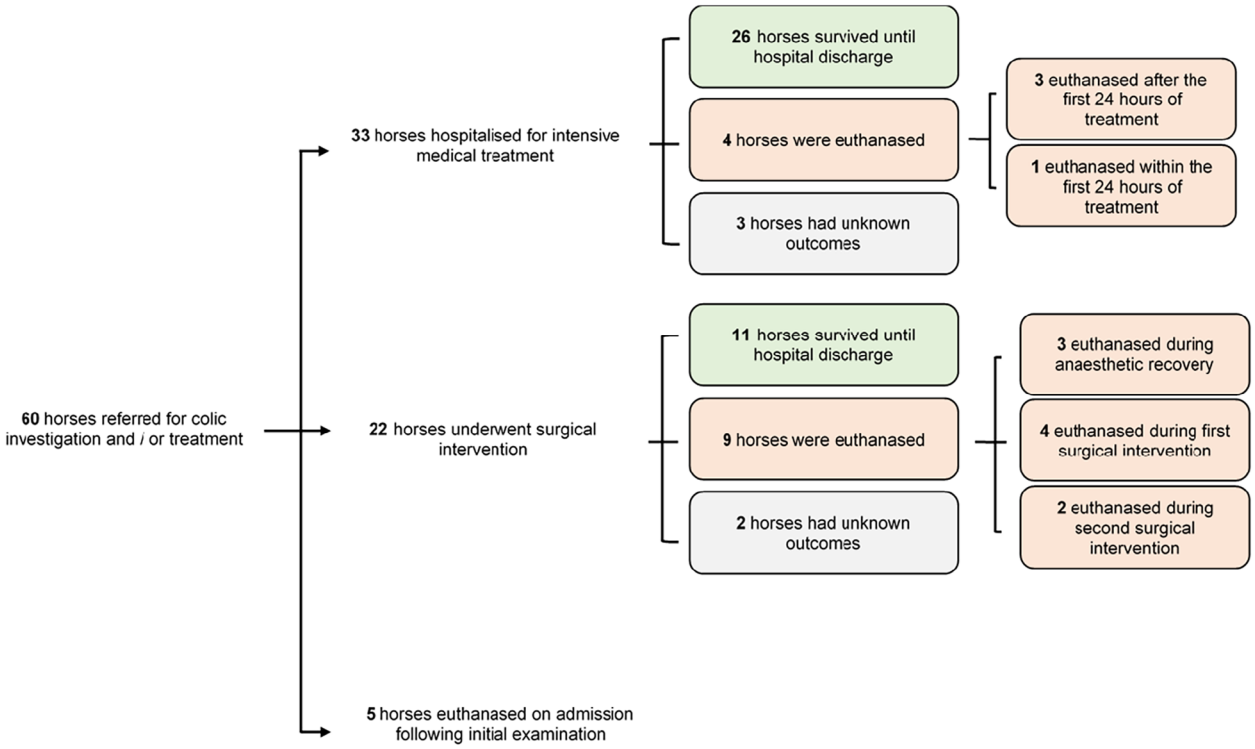

FIGURE 1 Short-term survival from an in-depth case analysis of 60 horses referred with signs of colic

(37%, 22/60) were the most common owner-reported signs.

The majority of horses (82%, 46/56) were admitted on the same day they were initially examined. Horses were admitted a median of 5 hours (IQR: 3–11, range: 0.5–170 hours) after being examined ($n = 42$).

Demeanour and behaviour severity on admission

Forty-three percent (26/60) of horses were quiet and responsive (QAR) on admission, 17% (10/60) were dull or depressed and 13% (8/60) were severely restless (Figure 1). Behaviour severity was recorded in 56 cases. Horses had a median combined behaviour score of 2 (IQR: 0–5, range: 0–12); however, the individual scores varied greatly (Supporting Information S3).

Clinical parameters

Clinical parameters on hospital admission are presented in Table 1. Self-trauma was present over the eyes or on the head in 33% (19/57) of horses.

Abdominal examination

Horses presented with varying degrees of abdominal distension and levels of borborygmi (Supporting Information S4). Sixty-seven percent (36/54) of horses had absent or reduced gut sounds in two or more abdominal quadrants. Four horses had increased gut sounds in two or more quadrants.

Drug administration and response to analgesia

Fifty-two (87%) horses received medication prior to hospital admission, predominantly from the attending practitioner (48/52). Four horses received medication from their owner (oral NSAIDs or antibiotics) (Supporting Information S5).

At least one drug (Supporting Information S6) was administered during the clinical examination in 73% (44/60) of cases. The majority (71%, 31/44) received hyoscine, mainly to facilitate rectal examination (21/23). Response to analgesia was recorded in 83% (50/60) of cases. An improvement in demeanour occurred in 26% (13/50) of horses; however, no change or deterioration was reported in 74% (37/50) of cases.

Diagnostic evaluation

A range of diagnostic procedures, including rectal examination, nasogastric intubation, abdominocentesis, abdominal ultrasound and haematology and biochemistry, were performed by veterinary practitioners (Supporting Information S7).

Diagnosis and treatment

A diagnosis was provided for 85% (51/60) of cases (Table 2). No definitive diagnosis was reported in nine cases (15%). Thirty-three (55%) horses received intensive medical treatment, 22 (37%) underwent surgical intervention and five (8%) were euthanased following the initial clinical examination.

TABLE 1 Clinical parameters at time of hospital admission in 60 horses referred with signs of colic

Clinical parameter (number of horses data was recorded for)	Clinical finding at the time of admission presented as median (IQR, range) or mode ($n = x/y$)
Heart rate ($n = 58$)	52 beats per minute (IQR: 43–60, range: 26–120)
Respiratory rate ($n = 53$)	16 breaths per minute (IQR: 12–20, range: 10–64)
Pulse character ($n = 45$)	'Strong' pulse ($n = 30/45$)
Mucous membrane colour ($n = 56$)	'Normal' colour ($n = 29/56$)
Mucous membrane hydration ($n = 55$)	'Moist' feel ($n = 36/55$)
Capillary refill time ($n = 51$)	<2.5 seconds ($n = 35/51$)
Rectal temperature ($n = 48$)	37.7°C (IQR: 37.4–38.0, range: 36.7–40.0)

Abbreviation: IQR, interquartile range.

TABLE 2 Diagnoses for 51 of 60 horses referred for colic treatment (nine horses did not have a definitive diagnosis and their data are not presented in this table)

Diagnosis	Number of cases with diagnosis	Number of horses receiving treatment		
		Medical	Surgical	Euthanasia
Small intestine				
Entrapment	3	0	2	1
Strangulation	5	0	5	0
Volvulus	1	0	1	0
Caecum				
Impaction	2	1	0	1
Large colon				
Impaction	1	1	0	0
Left dorsal displacement	4	3	1	0
Right dorsal displacement	8	6	2	0
Rupture of left ventral colon	1	1	0	0
Volvulus	3	0	3	0
Small colon				
'Abnormality'	1	0	1	0
Multiple pathologies				
Small intestinal strangulation and impaction	1	0	1	0
Impaction and left dorsal displacement	1	1	0	0
Impaction and right dorsal displacement	1	1	0	0
Large colon impaction and small intestinal entrapment	1	0	1	0
Right dorsal displacement and small intestinal strangulation	1	0	1	0
Multiple adhesions within abdomen	1	0	1	0
'Spasmodic'	2	2	0	0
No definitive diagnosis	9	6	2	1
Other				
Impaction (unspecified region)	2	2	0	0
Enteritis/colitis/enterocolitis	2	2	0	0
Rupture (unspecified region)	1	0	0	1
Unspecified strangulation	2	0	1	1
Lawsonia	1	1	0	0
Peritonitis	6	6	0	0

Factors considered significant in the formulation of the treatment plan were recorded in 98% (59/60) of cases. The majority (80%, 47/59) of horses underwent the chosen treatment due to the severity of clinical signs. Financial concerns were referred to in 10% (6/59) of cases, with ongoing health issues and a previous history of colic taken into consideration for 5% (3/59) of horses. Owner-related factors, such as inexperience, concern about box rest and an aversion to colic surgery, were also recorded (Table 3).

Of those treated medically, both enteral and intravenous fluids were given in 39% (13/33) of cases. Three horses (9%) required a second surgery due to postoperative complications, namely colonic torsion,

TABLE 3 Owner-related factors that influenced the treatment plan for 60 horses referred with signs of colic

Owner-related factor	Number of cases where factor identified
Severity of clinical findings	80% (47/59)
Financial constraints	10% (6/59)
Age of horse	5% (3/59)
Ongoing health issues	5% (3/59)
Previous history of colic	5% (3/59)
Concerns regarding equine welfare	3% (2/59)
No response to analgesia	3% (2/59)
Limitations of physical examination	2% (1/59)
Owner concerned about horse tolerating box rest	2% (1/59)
Owner declined surgical treatment	2% (1/59)
Owner inexperienced	2% (1/59)
Owner unable to manage horse at home	2% (1/59)
Owner wanted to do everything possible	2% (1/59)

small intestinal entrapment and persistent colic signs.

Presentation of euthanased horses

Horse demographics

The majority of euthanased horses were geldings (72%, 13/18), used for general/leisure purposes (33%, 6/18) and were uninsured (67%, 12/18).

Horse demeanour on admission and outcome

Demeanour on admission, response to analgesia and subsequent case outcome were recorded for 50 horses (Figure 2). The majority of these horses (23/50) were QAR on admission; 15 of these received medical treatment, six had surgical treatment and six were euthanased (one with no further treatment and five after medical or surgical treatment). Twelve horses were assessed as either moderately restless (4/50) or severely restless (8/50); 11 received surgical treatment, seven were euthanased (one with no further treatment and six after treatment) and the outcome was unknown for one.

Clinical features of horses undergoing euthanasia

On clinical examination, 12 of the 18 euthanased horses presented with pale mucous membranes and 10 with a capillary refill time of over 2.5 seconds. Absent gut sounds were also a common clinical finding. Euthanased horses had a median heart rate of 60 beats per minute (IQR: 50–75, range: 40–120 beats per minute), with a median respiratory rate of 20 breaths per minute (IQR: 16–40, range: 12–60 breaths per minute) also reported. These horses also had a higher combined behaviour severity score compared to those that survived, with a median severity score of 5 (IQR: 3–9, range: 0–10) calculated. Factors considered significant in the decision to euthanase, such as financial constraints and a poor prognosis, were recorded for all 18 cases (Table 4).

DISCUSSION

Previous studies have focused on clinical or diagnostic parameters that are statistically associated with case outcome and survival. However, there are a number of other contributing factors, and the final decision will be made by the veterinarian and owner based on the individual circumstances of each horse and its carer. This is the first study to use an in-depth case analysis approach to follow the referral journey from initial examination to final outcome for individual colic cases, with the aim of identifying these other critical decision-making factors. A collective case study approach was used to follow multiple cases to generate a broader understanding of the different factors and journeys, with the researcher cross-referencing findings and decisions within an individual horse over time and between different horses at similar points. The in-depth case study uses a naturalistic approach to explore causal links and pathways and identify new areas for study. This contrasts with an experimental study design that instead focuses on testing a hypothesis.[9]

The key aspects of case presentation and progression the authors considered to be of most clinical importance in this case study were as follows:

- There was a marked variation in time elapsed between the recognition of clinical signs and subsequent admission to a veterinary hospital between individual cases.
- The decision to pursue surgical or intensive medical treatment was most frequently based on the severity of clinical signs.
- All horses that were moderately or severely restless on admission had surgical treatment and/or euthanasia.
- Non-clinical factors, such as financial constraints, horse age and owner concerns regarding equine welfare, were important in critical decision making.

Owner recognition and response

Colic is multifactorial in nature, with signs and severity varying between individual horses, which can make it challenging for owners to recognise.[16] It was concerning that owners reported observing signs of abdominal pain an average of 15 hours after last seeing their horse behaving 'normally', and an average of 13 hours reportedly elapsed between the initial

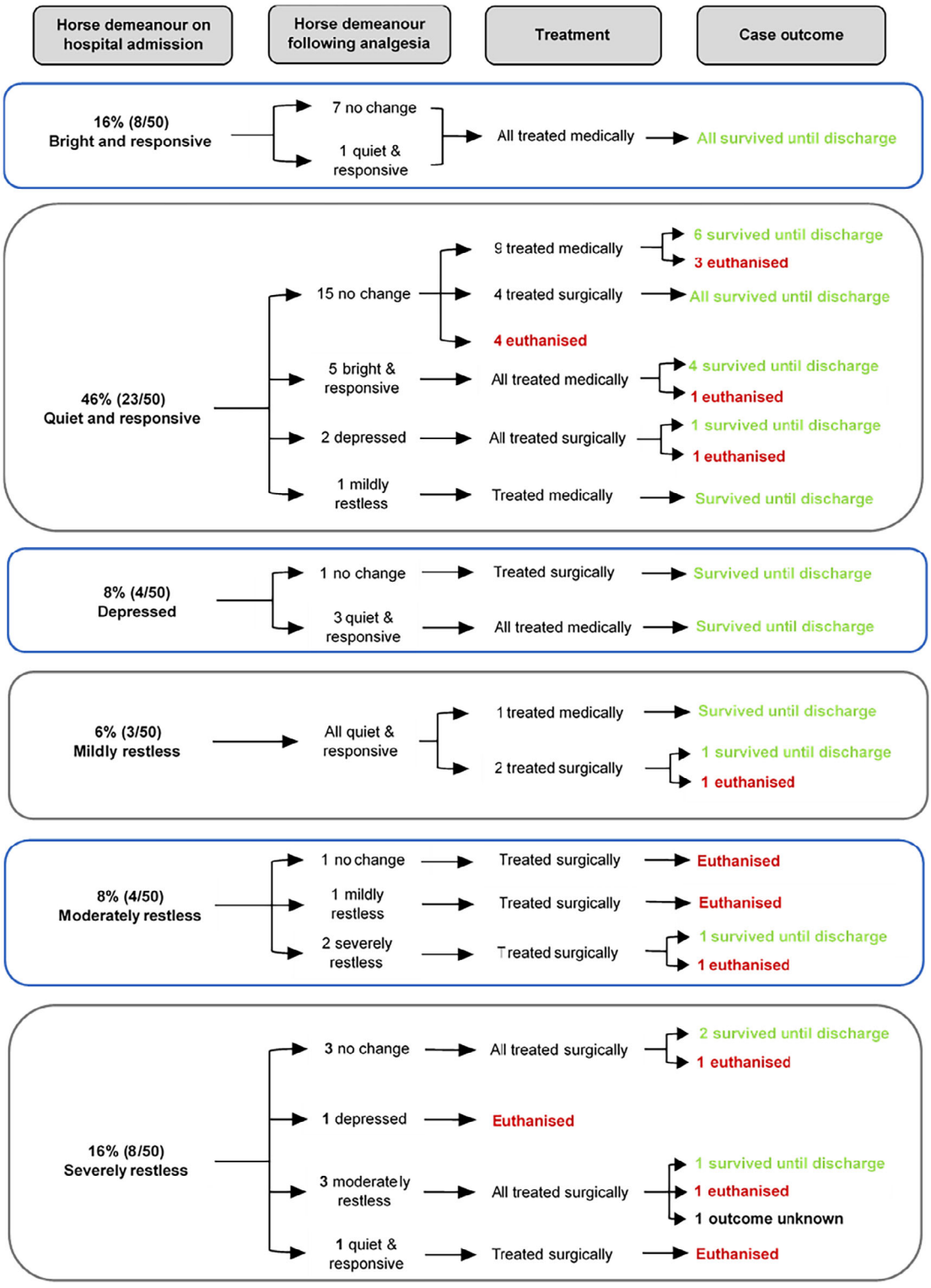

FIGURE 2 Demeanour of 60 horses referred with signs of colic following the administration of analgesia, and their presentation upon arrival at the referral hospital

veterinary examination and hospital admission. This was consistent with the 'wait and see' approach described in a previous study.[6] However, given the descriptive nature of this study and a bias towards a referral hospital population, conclusions relating to the impact of any delays on case outcome cannot be drawn. There is also a lack of evidence pertaining to the referral decision-making process, so reasons for treatment delays can only be speculated. This study highlights the need for further research into the reasons for, and impact of, any delays in seeking veterinary assistance.

Factors affecting decision making

This study identified several factors that can affect an owner's decision making. These can be categorised into horse factors (age, severity of condition and pre-existing condition) and owner-related factors (finance

TABLE 4 Factors associated with euthanasia decisions for 18 horses from a population of 60 horses referred with signs of colic (data presented relates to each individual of the 18 euthanased horses)

Treatment attempted	Diagnosis	Time of euthanasia	Main factor contributing to euthanasia decision
Medical	Rupture of left ventral colon	Within first 24 hours of medical treatment	Severity of clinical signs/poor prognosis
	Peritonitis	After first 24 hours of medical treatment	Deterioration of clinical signs and no response to analgesia
	No definitive diagnosis	After first 24 hours of medical treatment	Development of neurological signs and no response to analgesia
	Caecal impaction	After first 24 hours of medical treatment	Owner concerned regarding financial costs and requested euthanasia
Surgical	Large colon volvulus	During first surgical treatment	Poor prognosis due to extent of intestinal injury
	Multiple abdominal adhesions	During first surgical treatment	Owner concerned about horse returning to full athletic career
	Small colon abnormality	During first surgical treatment	Poor prognosis due to extent of intestinal injury
	No definitive diagnosis	During first surgical treatment	Poor prognosis due to extent of intestinal injury
	Displacement of the left dorsal colon	During anaesthetic recovery	Femoral fracture on recovery
	Small intestinal strangulation	During anaesthetic recovery	Femoral fracture on recovery
	Displacement of the right dorsal colon	During anaesthetic recovery	Femoral fracture on recovery
	Unknown	Following second surgical treatment	Postoperative colic and reflux
	Small intestinal volvulus	Following second surgical treatment	Postoperative ileus and increasing reflux
No treatment—euthanasia	Gastrointestinal rupture	After initial hospital assessment	Food material observed in peritoneal fluid
	No definitive diagnosis	After initial hospital assessment	Owner concerned regarding financial costs
	Strangulation (unspecified)	After initial hospital assessment	Owner concerned about horses age and underlying heart murmur
	Small intestine entrapment	After initial hospital assessment	Owner concerned about horses age and quality of life
	Caecal impaction	After initial hospital assessment	Owner concerned regarding financial costs and surgery was not an option

and previous experience).[6,17] The survival rate of horses undergoing surgical exploration within this study was consistent with figures previously reported; however, survival to discharge (67%) appears to be lower than that published in these studies. One potential reason for this discrepancy could be the limited sample size of this study, which may have led to an over-representation of horses with critical illnesses, and the inclusion of cases that were euthanased at admission or during surgery.

The majority of treatment decisions, including euthanasia, were reported to be based on the severity of clinical signs, consistent with existing evidence. Poor cardiovascular status and severity of pain have been associated with an increased risk of mortality across a number of studies.[17–23] In this small cohort, lack of response to analgesia was variable in horses that required surgery or did not survive, but many showed severe pain (Figure 1). The finding that all horses that were moderately or severely restless on admission had surgical treatment and/or euthanasia is consistent with previous studies[24] but warrants further investigation in a larger study to validate it as a key 'red flag' indicator of these outcomes.

The number of older horses that were euthanased in this study may have been the result of illness severity, with elective euthanasia being attributed to poor prognosis in several cases; however, a number of horses were reportedly euthanased due to owner concerns regarding 'old age' and subsequent quality of life. This finding would coincide with the suggestion of Southwood et al.[25] that a higher rate of euthanasia in geriatric horses is more likely attributed to owner preference rather than a poor prognosis. However, the decision to euthanase has also been reported to be based on misconceptions regarding the effect of age on recovery.[26]

This study aimed to ascertain both clinical and non-clinical factors associated with the treatment and survival of horses diagnosed with colic using a detailed medical history for each horse. It identified a number of non-clinical factors, such as finance, affecting decision making. It is reasonable to assume that owners had been made aware of the financial costs of hospital treatment prior to referral. However, a large proportion of horses were euthanased prior to surgical intervention or intra-operatively due to financial concerns. While apprehensions regarding the cost of

colic treatment have been previously associated with the intra-operative euthanasia of horses,[27] there has been little research investigating how cost actually impacts horse owner decision making. A study by Barker and Freeman[28] evaluated the financial implications of colic at five UK referral hospitals and reported average costs ranging from £800 for euthanasia to over £6000 for surgical intervention. Given the potential welfare implications associated with the transportation and treatment of critically ill horses, the fact that some owners are choosing to refer their horse despite not having the funds is concerning and again warrants further research. Future studies to understand the complex nature of owner decision making should employ a qualitative methodology to explore these further and understand the impact of the horse–human relationship on these decisions.

Study limitations

This study used prospective data collection and in-depth and cross-case analysis to explore detailed information about cases and decisions. The main limitation is the small numbers of cases and practices involved and variability associated with different types of colic. Previous studies of colic survival and outcome have focused on quantitative data; cases euthanased at admission or during surgery are frequently excluded from analysis, and factors affecting owners' decision making are rarely recorded. Although this is a small sample size compared to previous epidemiological studies,[3,11,27,29,30] the current study collected both quantitative and qualitative data, enabling contextualised data to be analysed for individual cases. The decision-making factors were recorded using open free-text boxes, allowing themes to emerge from the data rather than giving predefined options or testing existing hypotheses. However, given the small size of the study population, the results cannot be considered representative of the UK horse population. This study also reported on referral hospital cases, which may have resulted in bias towards owners who had appropriate funds or insurance. The factors involved in decision making that emerged from this study warrant further exploration in the wider horse population and incorporation into future research studies.

Future recommendations

Based on this in-depth case analysis approach, the authors recommend that the following aspects should be included in clinical case recording and future research studies:

- History to include: age, use, current health, previous history of colic in the horse and owner's previous experience of colic.
- Clinical assessment to include: assessment of pain, behaviour and cardiovascular and gastrointestinal parameters both on admission and following treatment.
- Critical decision-making factors to include: finance/insurance, previous history and owner experience (as above), facilities/welfare of horse during box rest, owner concerns and relationship with horse and case progression/development of complications.

CONCLUSIONS

This study adds to a growing body of evidence on critical decision making for horses with colic. It has been documented that some cases may experience significant delays before the initial veterinary assessment and subsequent hospital admission, but the reasons for this and how this impacts outcome is currently unknown. The decision to pursue surgical or intensive medical treatment was predominantly based on severity of clinical signs, including both clinical parameters and demeanour, and the assessment and continued monitoring of these during case assessment and treatment is essential. The most common reasons for elective euthanasia of referred horses in this study were deteriorating clinical parameters and a low chance of survival. However, factors such as financial constraints, the horse's age and owner concerns regarding their welfare were key in decision making for individual owners and cases. These owner-related factors are often not routinely recorded or assessed in clinical research. This was a small-scale study, but it highlighted how future studies should strive to understand the influence of owner-related factors and their importance in life and death decisions in horses with colic.

AUTHOR CONTRIBUTIONS

Katie Burrell was the primary researcher and primary author, contributing to the study conception and design, data acquisition, analysis and interpretation. Georgina Sutton-Walker contributed to data analysis and interpretation. John Burford, Gary England and Sarah Freeman contributed to the study conception and design, data analysis and interpretation. All authors contributed to manuscript preparation, approved the final version and agree to be accountable for the accuracy and integrity of the work.

ACKNOWLEDGEMENTS

The authors would like to thank the participating practices and veterinary surgeons. Katie Burrell's PhD studentship was funded by the University of Nottingham and World Horse Welfare.

CONFLICT OF INTEREST STATEMENT

The authors declare they have no conflicts of interest.

DATA AVAILABILITY STATEMENT

Additional data are provided in the Supporting Information. The data that support the findings of this

study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

The study was reviewed and approved by the University of Nottingham's School of Veterinary Medicine and Science Ethics Committee. Data collection and anonymisation were conducted in accordance with the 1998 Data Protection Act and the British Educational Research Association's Revised Ethical Guidelines for Educational Research (2004).

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Burrell K, Sutton-Walker G, England GCW, Burford JH, Freeman SL. Prospective case study of critical decision making for horses referred for treatment of colic. Vet Rec. 2023;e3615. https://doi.org/10.1002/vetr.3615