**Outcome following emergency laparotomy in 33 UK donkeys: a retrospective multicentre study**

Mathilde S. Merridale-Puntera\*, Jamie S. W. Pruttonb., Darko Stefanovskic, Francesca C. F. Worsmand, Richard J. Paynee, Claire E. Wylief,e, Debra C. Archerg, Nicola Menzies-Gowh, Lydia Colesi, Kate McGovernj, Russell A. Parkerb

a The University of Melbourne, Faculty of Veterinary and Agricultural Sciences, Werribee, VIC, AUS

b Liphook Equine Hospital, Liphook, Hampshire, UK

c University of Pennsylvania, Clinical Studies- New Bolton Center, Kennett Square, PA, USA

d The Royal (Dick) School of Veterinary Studies, University of Edinburgh, Roslin, Midlothian, UK

d University of Edinburgh Royal Dick School of Veterinary Studies, Equine Hospital, Midlothian, Easter Bush, UK

e Rossdales Equine Hospital, Exning, Newmarket, Suffolk, UK

f The University of Sydney, Sydney School of Veterinary Sciences, Sydney, NSW, AUS

g University of Liverpool, Equine Hospital, Leahurst Campus, Neston, UK

h Royal Veterinary College, Hawkshead Lane, North Mymms, Hertfordshire, UK

i Bourton Vale Equine Clinic, Wyck Rd, Lower Slaughter, Cheltenham, UK

j Donnington Grove Veterinary Surgery, Oxford Road, Newbury, Berkshire, UK

\*Corresponding author: mseabramerri@student.unimelb.edu.au

**Keywords:** Donkey, exploratory laparotomy, colic

**Summary**

**Background:** Emergency laparotomies in donkeys for investigation and treatment of colic are infrequently performed and there is limited literature on the subject.

**Objectives**: To determine findings and associated outcomes of exploratory laparotomies in donkeys.

**Study Design:** Descriptive retrospective study.

**Methods:** Donkeys undergoing emergency exploratory laparotomy for investigation and treatment of colic at seven UK referral hospitals between 2005-2017 were included.Data were retrieved from available hospital records. Descriptive statistics and inferential statistical analysis of outcomes of interest was performed in three steps.

**Results:** Thirty-three cases fulfilled the inclusion criteria. Clinical signs on presentation were available for 32 donkeys, of which 53.1% (17/32) presented for investigation of colic while in 46.9% (15/32) the presenting complaint was nonspecific. Primary lesion location included small intestine (42.4%, 14/33), large colon (39.3%, 13/33), caecum (6.1%, 2/33), stomach (6.1%, 2/33) and 6.1% (2/33) had multiple abnormal findings without a clear primary lesion. Overall survival to discharge was 54.5% (18/33). Five donkeys (15.2%, 5/33) were euthanased at surgery and of those recovering from general anaesthesia a further 35.7% (10/28) were euthanased or died prior to discharge. Six donkeys (21.4%, 6/28) required a second laparotomy of which 4 (66.7%, 4/6) survived. Post-operative complications occurred in 82.1% (23/28) of cases and included hyperlipaemia (42.9%, 12/28), incisional complications (21.4%, 6/28), ileus (21.4%, 6/28) and persistent colic (17.9%, 5/28). When adjusted for other complications, donkeys with primary gastric lesions were less likely (p=0.05) to have presented with severe colic compared to those with primary small intestinal lesions (OR: 0.07, 95%CI 0.01-0.95). Only age was positively associated (p=0.02) with death prior to discharge.

**Main Limitations:** Small sample size and retrospective design.

**Conclusion:** Donkeys with abdominal lesions may present with a range of signs often not including colic.Surgical findings were diverse and survival to discharge appears to be lower than in horses.

1. **Introduction**

It is anecdotally recognised that donkeys have a higher pain threshold than horses, or are less demonstrative of pain in response to noxious stimuli. Pain is an important factor in the decision making of colic cases[1, 2], and the donkey’s stoicism can make triaging of colic cases challenging, particularly in an ambulatory setting. Additionally, in contrast to horses, emergency exploratory laparotomies in donkeys for the further investigation and treatment of colic are infrequently performed in the UK. Although there are fewer donkeys than horses in the UK[3, 4], the limited literature on this subject makes it difficult for clinicians to take informed decisions and provide evidence-based advice and prognosis to owners.

It is estimated there are over 27,000 donkeys in the UK[5] with an increase in population seen over the previous decades[3]. Colic is less frequently diagnosed in the donkey than the horse[3, 6] and a 2010 study surveying a population of over 1000 UK donkeys found that only 1% of animals had colic over a 1 year period[3] compared to a cumulative incidence of 5.8% in UK Thoroughbreds[6]. Management factors, weight loss, dental pathology and recent vaccination were identified as risk factors for the development of impaction in UK donkeys[7], most commonly pelvic flexure impactions[7]. Amongst the colic diagnoses in this species, impaction colic is frequently documented and can be associated with a high mortality rate[3, 7]. However, there is little evidence-based knowledge of other types of colic in the donkey, as well as their aetiology, presentation and prognosis.

In the UK, exploratory laparotomies in horses are frequently performed for the further investigation and treatment of colic. Primary small intestine (SI) pathology is present in approximately 42-49% of equine exploratory laparotomies and, similarly, primary large intestine pathology is seen in 42-53% of horses[8, 9]. Most studies of the past two decades found short-term survival rates above 70% for horses with small or large intestinal primary lesions[9-11]. However, such figures are not known for exploratory laparotomies in donkeys.

The aim of this retrospective multicentre study was to investigate the presentation of surgical colic cases in UK donkeys and determine the main findings and associated outcomes of exploratory laparotomies in this species.

1. **Materials and Methods**

Seven equine referral hospitals located in Scotland, Cheshire, Berkshire, Hertfordshire, Suffolk, Hampshire and Devon were invited to participate in the study. Participating hospitals were asked to complete a standardised spreadsheet with information retrieved from the available clinical records of donkeys that had undergone exploratory laparotomy at their institution. Inclusion criteria were existing clinical records of donkeys that had undergone exploratory laparotomy for the investigation and treatment of colic during 2005-2017. Exclusion criteria were records of exploratory laparotomies performed for reasons unrelated to colic and equids other than donkeys. Clinical information was compiled by qualified veterinarians in each hospital. Data collected included signalment, history, pre-operative medical therapy, surgical findings and intervention, post-operative care, post-operative complications, survival to discharge and survival at 6 and 12 months. Data were extracted exclusively from the available clinical records of participating hospitals and no additional follow-up was done.

The information retrieved from hospital records included a description of clinical signs shown by the donkeys on admission and were categorized into mild, severe and non-specific colic signs. Where a statement of colic severity was already provided in the records, the case was categorized according to that severity. Where only clinical signs were included without specific mention to colic severity, categorization was done in consultation with a board-certified equine surgeon and an internal medicine specialist and a consensus achieved for all cases. The category of severe colic signs included records of rolling, sudden onset uncontrollable colic, lateral recumbency, violent rolling with muscle tremors, rapid progression of signs. Mild colic signs included low-grade colic, lying in sternal recumbency with colic signs, quiet with colic signs, lying still and kicking at the belly, tucked up and uncomfortable. The category of non-specific signs included records of anorexia or inappetence, dullness, depression, weight loss, decreased faecal output, hyperlipemia and signs of choke.

Medical management prior to surgery was defined as any attempt to medically treat colic before a decision was made to proceed to surgery. Pre-operative fluid therapy or drug protocols intended only to stabilize and prepare the patient for surgery were therefore not considered as medical management. The nature of the therapy attempted before and after surgery was not considered for analysis due to the heterogenicity of data. For all cases, classification of laparotomy findings according to primary lesion location was achieved by consensus between the same board-certified equine surgeon and internal medicine specialist. Categories consisted of primary gastric lesions, small intestinal lesions, large colon lesions, caecum lesions and multiple lesions without obvious primary cause. Serum lactate analysis was based on a cut-off value of 2mmol/L as the mean lactate concentration associated with colic survival outcome in horses[12]. Donkeys with blood lactate values of 2mmol/L or lower were considered to have normal lactate levels and blood lactate values above 2mmol/L were considered high.

* 1. **Statistical Methods**

All analyses were conducted using Stata 16.1MP (StataCorp, College Station TX) with two-sided tests of hypotheses and a p-value ≤ 0.05 as the criterion for statistical significance. Age and heart rate were analysed as continuous variables and the remaining variables were categorised (body condition score, duration of colic signs prior to referral, nasogastric reflux on arrival, blood lactate on arrival, attempted medical therapy, primary lesion location, intra-operative euthanasia, post-operative complications, survival to discharge, survival 6 months post-laparotomy and survival at one year post-laparotomy).

Descriptive analyses included computation of medians and ranges of continuous variables and tabulation of categorical variables. Normality tests (Shapiro-Wilk test) were performed to determine the extent of skewness of the data. Frequency counts and percentages were used for categorical variables (e.g., sex, severity of colic signs on presentation and others). Inferential statistical analysis of the outcomes of interest (colic on presentation and death of the animal prior to discharge) were analysed in three steps. First, univariate ordinal logistic regression was used to identify independent variables associated with colic as the dependent variable. Univariate firth logistic regression was used to identify independent variables associated with death prior to discharge as the outcome of interest. Only independent variables (including confounders such as sex, age, breed and others) showing statistical trends (P<0.2) were included in subsequent analysis. Age, severity and duration of clinical signs on presentation, serum lactate on presentation, pre-operative medical management, primary lesion location, post-operative complications and repeat laparotomy variables were considered for inclusion in the model for survival from hospital. Second, a manual backwards stepwise algorithm was used to identify the subset of independent variables that were associated with the outcome of interest. Inference were based on the final multivariable models for both outcomes of interest (colic and died in hospital (Yes/No)). To permit for some imbalances between groups introduced by missing value, robust estimation of the variance was used.

1. **Results**

The records of 34 exploratory laparotomies were retrieved by the participating hospitals and one record was excluded as it referred to a mule patient. Clinical records of 33 donkeys undergoing exploratory laparotomy for the investigation and treatment of colic between 2005 and 2017 were included as the study population. The donkey population consisted of 13 females (jennets), 18 gelded males and 2 non-castrated males (jacks). Median age was 9 years (range 5 weeks-25 years, IQR 12 years). Breed was not recorded for most donkeys but the population included 2 Poitou and 3 miniature donkeys.

Clinical signs on presentation to the referral hospital were obtained for all but one donkey (97%, 32/33) and were categorised as non-specific signs including dullness, inappetence and weight loss (46.9%, 15/32), mild colic signs (15.6%, 5/32) and severe colic signs (37.5%, 12/32) (Table 1). Presenting heart rate was available for all cases (100%, 33/33), duration of colic signs before referral was available in 30 cases (90.9%, 30/33), a nasogastric tube was passed in 25 donkeys (75.8%, 25/33) and values for serum lactate were available in 16 cases (48.5%, 16/33). Median serum lactate was 2.7mmol/L, (range 0.8 to 6.5mmol/L, IQR 1.6mmol/L). Clinical findings on presentation to referral hospital and short-term survival are presented in Table 1.

Medical management of colic at the referral hospital was attempted in 12 donkeys (36.4%, 12/33) before the decision to perform surgery. The duration of the medical therapy was ≤24 hours in 58.3% (7/12) of donkeys and >24 hours in 41.6% (5/12), ranging from 36 hours to 5 days.

The reason for laparotomy was recorded in 26 cases (78.8%, 26/33). In five cases the decision to proceed to surgery was based on pain (19.2%, 5/26), pain and diagnostic findings (11.5%, 3/26) or pain and no-response to therapy (11.5%, 3/26). In eight cases this decision was based on diagnostic findings (30.8%, 8/26), to obtain a diagnosis (11.5%, 3/26) or biopsies (3.8%, 1/26) and due to clinical deterioration (7.7%, 2/26) or no response to therapy (3.8%, 1/26).

***TABLE 1***

* 1. **Exploratory Laparotomy Findings**

Exploratory laparotomy findings were categorised according to location of the primary lesion, into small intestine (SI) (42.4%, 14/33), large colon (39.3%, 13/33), caecum (6.1%, 2/33) and gastric (6.1%, 2/33) primary lesions. Two donkeys (6.1%, 2/33) had multiple abnormal findings on laparotomy without a clear primary lesion. Three donkeys (9.1%, 3/33) had intra-luminal obstructions with a discrete mineral or organic mass. Three gastrointestinal ruptures were diagnosed at laparotomy involving the caecum (66.7%, 2/3) and large colon (33.3%, 1/3). Cases of primary gastric pathology (6.1%, 2/33) consisted of firm gastric impactions. Of the cases with primary small intestinal pathology, 28.6% (4/14) were strangulating lesions and 21.4%, (3/14) had intraluminal obstructions. Strangulating SI lesions included two cases of volvulus (14.3%, 2/14), one strangulation caused by a deep adhesion band (7.1%, 1/14) and one strangulation of unclear origin (7.1%, 1/14). SI obstructions were due to an enterolith (7.1%, 1/14), a firm organic mass in the proximal jejunum (7.1%, 1/14) and a non-specified ileal impaction (7.1%, 1/14). For primary large colon lesions, 46.2% (6/13) were displacements and 7.7% (1/13) were torsions. Intraluminal obstructions were seen in 23.1% (3/13) of large colon lesions, of which one was a pelvic flexure impaction (7.7%, 1/13), one was a left dorsal colon enterolith (7.7%, 1/13) and the other a primary dorsal colon obstruction caused by a 5cm thickening of the bowel extending 30cm along length of dorsal colon (7.7%, 1/13).

* 1. **Post-operative complications**

Post-operative complications occurred in 82.1% (23/28) of cases recovering from general anaesthesia and included hyperlipaemia (42.9%, 12/28), incisional complications (21.4%, 6/28), intravenous catheter complications (17.9%, 5/28), ileus (21.4%, 6/28) and persistent colic (17.9%, 5/28). Twenty-one percent (6/28) of donkeys recovering from general anaesthesia (18% of the initial population) required a second laparotomy. The main surgical findings from the second laparotomy are shown in Table 2.

***TABLE 2***

* 1. **Survival outcomes**

Five donkeys (15.2%, 5/33) were euthanised during the first surgery due to poor prognosis and of those recovering from general anaesthesia (28/33) a further 35.7% (10/28) were euthanised or died prior to discharge (*figure 1*). Of the six donkeys (21.4%, 6/28) that underwent repeat exploratory laparotomy 83.3% (5/6) recovered from the second anaesthetic and 66.7% (4/6) survived to discharge (*figure 1*).

Laparotomy findings of donkeys not surviving to discharge consisted of small intestinal (SI) strangulation (6.7%, 1/15), large colon torsion (6.7%, 1/15), two viscous ruptures (large colon and caecum) (13.3%, 2/15), SI impaction (6.7%, 1/15), SI enteritis (13.3%, 2/15), large colon and caecum impaction (6.7%, 1/15), gastric impactions (13.3%, 2/15), distended SI distention without physical obstruction (13.3%, 2/15), colon obstruction by thickening of the bowel wall (6.7%, 1/15), non-strangulating infarction of the colon and caecum (6.7%, 1/15) and a case of multiple serosal inflammation and vasculitis of unclear origin (6.7%, 1/15). The median age of donkeys surviving to discharge was 7 years (range 5 weeks-20 years, IQR 6 years) while the median age of donkeys not surviving to discharge was 14 years (range 1.7-25 years, IQR 5.5 years).

***FIGURE 1***

The prevalence and hospital mortality according to analysed variables are presented in Table 3.

Univariate logistic regression identified only the age of the animal to be significantly associated (p=0.02) with death prior to discharge. Hence the final model only included the age of the animal. For each one year increase in age, the likelihood of death prior to discharge significantly (p=0.02) increased by 18% (OR: 1.18, 95%CI 1.03-1.36) (supplementary material 1, p3).

When adjusting the colic model for other complications, animals with primary gastric lesions were found to be less likely (p=0.05) to have presented with severe colic compared to animals with primary small intestinal lesions (OR: 0.07, 95%CI 0.01-0.95) (supplementary material 2, p13-14).

**TABLE 3**

Long-term follow-up was only available in 33.3% of cases (6/18) through subsequent hospital records of the same patients. Of these, 83.3% (5/6) were alive 6 months post-operatively and 16.6% (1/6) were not. Four animals (66.7%, 4/6) were also known to be alive 1 year after discharge from hospital.

1. **Discussion**

In the horse, the level of pain helps to differentiate critical from non-critical colic cases[13] and it is widely used as a decision criteria to perform an exploratory laparotomy. The intensity of colic signs and colic duration have been linked with prognosis and are associated with a higher mortality when increased[14, 15]. In the present study, only 37.5% of donkeys displayed severe signs of colic and nearly half the donkeys undergoing exploratory laparotomy (46.9%) did not show overt signs of colic. Instead, only non-specific signs (such as dullness, anorexia and weight-loss) were recorded on admission, which supports the results of Cox et al.[3] who found anorexia to be the most common presenting sign of colic in the donkey. The majority of donkeys were referred to hospital after more than 12 hours of displaying abnormal behaviour and 30% were referred after more than 3 days from the onset of clinical signs. Nevertheless, neither the severity of clinical signs nor their duration prior to referral were associated with an increased risk of mortality in hospital. This contrasts with the horse where the majority of laparotomies have been reported to take place after less than 12 hours of preoperative colic[8]  with only 15% later than 48 hours[8], and where duration of colic signs is significantly associated with survival[15]. Although the current study is limited by a small sample size and non-significant associations could be due to low power, the later referral of donkey patients could suggest a difference in pain manifestation between the two species or in the recognition of pain and colic severity by donkey owners and referring veterinarians. Further work to improve our understating of donkey behaviour and to investigate the recognition of colic in the donkey by owners and veterinarians would be beneficial.

In the horse, heart rate has a well-described predictive value for surgery and survival[16-18] which was not observed in this study. However, only presenting heart rate was considered in this study and a smaller sample of animals included. Similarly, blood lactate concentration did not appear to have the same prognostic value in the donkey that it has in the horse[11, 19], although results might be affected by the small sample size and retrospective study design. Peritoneal lactate has a stronger prognostic predictive value than blood lactate[20] which was not considered for analysis in this study due to the sparseness and heterogenicity of the data retrieved. Further research should be done to investigate the significance of pre-operative variables as predictors of outcome in donkeys.

Laparotomy findings in the studied population were diverse. Although the majority of laparotomies revealed primary small intestine pathology, nearly as many donkeys had primary large colon lesions. Eighteen percent of cases showed gastric, caecal or no obvious primary pathology, which is higher than the incidence of other abdominal pathologies described in the literature for horses[8, 9]. There were three cases of viscus rupture (2 caecal and one large colon) of which only one donkey had been recorded as displaying signs of severe colic. Three donkeys (9%) had well defined intraluminal obstructions of the small or large intestines which appears to be a relatively high percentage for a UK based population of animals.

Both cases of primary gastric pathology consisted of gastric impactions, diagnosed pre-operatively and receiving medical treatment for more than 48 hours. It is not known whether these cases were associated with hepatic failure which could have influenced the prognosis. However, both failed to resolve and further deteriorated post-operatively ultimately leading to euthanasia of the animals.

Horses with primary small intestinal or caecal lesions have a lower survival than those with primary colonic pathology[8, 9, 11, 21] although this was not true for the studied population of donkeys. None of the donkeys with primary gastric or caecal pathology, nor those with multiple lesions without a clear primary cause survived to discharge. Despite that, when adjusted for other complications, donkeys with primary gastric lesions were less likely to have presented with signs of severe colic compared to those with primary small intestinal pathology.

Eighty-two percent of donkeys recovering from general anaesthesia developed one or more post-operative complications. Hyperlipaemia was the most commonly reported complication (42.9%), while in the horse it has been reported in less than 1% post-laparotomy patients[22]. This is perhaps not surprising as donkeys commonly develop hyperlipaemia in response to illness or stress[23]. Additionally, although in this study data on the body condition of donkeys was missing from most cases, in the UK approximately one third of donkeys are overweight[3] which further increases the risk of developing hyperlipaemia[24]. However, in some cases only blood triglyceride concentrations were considered for its classification and the assumptions involved increase the risk of a false positive result. Due to the severity of complications associated with hyperlipaemia in donkeys, it would be sensible to closely monitor and treat animals at high risk irrespective of the results in the study.

This study observed a higher incidence of post-operative ileus than that described in the horse (21.4% versus 13.7%)[22] despite a similar survival to discharge of donkeys with post-operative reflux[11]. Although in this study donkeys seemed to have a lower incidence of post-operative colic than the horse (17.9% versus 28% or higher in the horse)[11, 22, 25], there was a large prevalence of “other” complications, several of which included dullness and anorexia which in the donkey could be interpreted as non-overt signs of colic. Therefore, the true incidence of post-operative pain is likely to be closer to that reported in the horse.

Repeat laparotomy within the same hospitalisation period was performed in 21% of donkeys recovering from the first general anaesthesia. This is a higher percentage than <11% reported in the horse[25, 26]. Nevertheless, this did not increase the likelihood of mortality and two thirds of the donkeys undergoing a second laparotomy survived to discharge from hospital, which is more than the 44.8%[26]-48.2%[25] reported short-term survival for horses.

In the present study, intra-operative euthanasia was performed in only 15% of laparotomies and represents one third of all mortalities prior to discharge. Although there is no data for colic mortality in donkeys that did not undergo surgery, this appears to be lower than the horse, where 40-55% of colic mortalities occur intra-operatively[11, 15] due to financial concerns or poor prognosis.

The overall survival to discharge was 54.5%. Although this is in line with some short-term survival reports following exploratory laparotomy in horses[15, 27], most studies since the year 2,000 report survival to discharge of ≥70%[9, 11] which is considerably higher than in this study. This could potentially be due to a reduced familiarity with the expectations and prognosis of exploratory laparotomies in donkeys, but little information was available regarding the reason for euthanasia in animals included in this study.

Increasing age was found to be associated with a higher risk of hospital mortality (including intra-operative euthanasia), which is consistent with reports of colic surgery in the horse[17, 28]. However, this was the only significant predictor of mortality found in the donkey, suggesting that both species must be considered differently. Nevertheless, non-significant results could be affected by the small sample size and more research should be done to investigate risk factors for mortality following exploratory laparotomy in donkeys.

Limitations of this study are significant and include the small sample size and the use of retrospective data from clinical records. The husbandry and feeding regime of donkeys was not considered in this study. Being a multi-centre study there is unavoidable heterogeneity of case management, supportive care, treatment protocol and clinical reasoning. Certain variables such as hyperlipaemia and nasogastric reflux were categorised by respondents as yes or no answers without further quantitative information. Physical examination findings and medication given during the pre-referral period are not known and other factors such as surgery time, general anaesthetic protocol and surgeon experience were not taken into account. Additionally, the role of owner decision in euthanasia during surgery was not available in the data obtained from clinical records. There is a recognised paucity of complementing clinical information to contextualise individual outcomes and findings of this study cannot be extrapolated to other populations of donkeys. Results obtained can be affected by the small sample size and lack of statistical power and must therefore be interpreted with care. However, despite the many limitations, this study provides an initial insight into the epidemiology of exploratory laparotomies in donkeys in the UK which is not documented in the literature.

In conclusion, donkeys with abdominal lesions may present with a wide range and severity of clinical signs, which often do not include signs of overt colic. As a likely consequence, a large proportion of donkeys were only referred to surgery several days after the onset of pathology. Surgical findings were diverse and there was a high incidence of post-operative complications, in particular hyperlipaemia and repeat laparotomy. Survival to discharge from hospital was lower than reported in horses undergoing exploratory laparotomy[9, 10], despite a lower intraoperative mortality. Age was the only variable associated with hospital mortality following colic surgery. Although further larger studies are required, this work addresses some important aspects of exploratory laparotomies in donkeys in the UK and highlights that colic in this species cannot be viewed in direct comparison to horses.

**Acknowledgements**

The author thanks the remaining co-authors and all the referral institutions that contributed for this study with their clinical data: Liphook Equine Hospital, Rossdales Veterianry Surgeons, Royal Veterinary College Equine Practice and Referral Hospital, Philip Leverhulm Equine Hospital, The Dick Vet Equine Hospital, Western Counties Equine Hospital and Donnington Grove Veterinary Group.

**Word Count:** 4692 (excluding abstract), 4992 (including abstract)

**Declarations:**

**Authorship:** All authors actively contributed to the conceptualisation, drafting, critical review and editing of the manuscript. All authors approved of the final version of the submitted manuscript.

**Authors’ declaration of interest:** No competing interests have been declared.

**Funding:** This research received no funding.

**Ethical animal research:** Research ethics committee oversight not required for this study.

**TABLE1:** Clinical findings on presentation to referral hospital and short-term survival

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | |  | No. | % | STS% |
| Severity of colic signs | | |  |  |  |
|  | Non-specific signs | | 15/32 | 46.9 | 53.3 (8/15) |
|  | Mild colic signs | | 5/32 | 15.6 | 60.0 (3/5) |
|  | Severe colic signs | | 12/32 | 37.5 | 58.3 (7/12) |
| Duration of clinical signs | | |  |  |  |
|  | <12 hours | | 8/30 | 26.7 | 50.0 (4/8) |
|  | 12 – 72 hours | | 13/30 | 43.3 | 69.2 (9/13) |
|  | >72 hours | | 9/30 | 30.0 | 44.4 (4/9) |
| Heart Rate | | |  |  |  |
|  | ≤44 bpm | | 5/33 | 15.2 | 80.0 (4/5) |
|  | 48 – 70 bpm | | 18/33 | 54.5 | 44.4 (8/18) |
|  | >70 bpm | | 10/33 | 30.3 | 60.0 (6/10) |
| Nasogastric reflux | | |  |  |  |
|  | Yes | | 11/25 | 44.0 | 63.6 (7/11) |
|  | No | | 14/25 | 56.0 | 64.3 (9/14) |
| Serum lactate | | |  |  |  |
|  | ≤2 mmol/L | | 4/16 | 25.0 | 100.0 (4/4) |
|  | >2 mmol/L | | 12/16 | 75.0 | 50.0 (6/12) |
| STS = short-term survival (survival to discharge)  bpm = beats per minute | | | | | |

**TABLE 2:** Main surgical findings and outcome of donkeys undergoing 2 exploratory laparotomies under the same hospitalisation (n=6)

|  |  |  |  |
| --- | --- | --- | --- |
| Age (years) | 1st Laparotomy Findings | 2nd Laparotomy Findings | Survival to Discharge |
| Unknown | SI strangulation of unclear origin.  10feet jejunal resection | Fibrinous serositis at anastomosis site | No |
| 8 | Aboral SI volvulus  13feet resection, jejuno-ileal anastomosis  Gastric impaction  Ventral colon impaction | Distended small intestine  Ischemic areas of mesentery  Anastomosis patent | Yes |
| 3 | Non-strangulating SI obstruction by enterolith  Distended small intestine  5feet resection and jejuno-jejunal anastomosis | Large colon impaction | Yes |
| 20 | Ascending colon displacement  SI ileus | Recurrence of right dorsal displacement  Caecal impaction | Yes |
| 10 | Gas and fluid distension of SI  Inflammation of SI, large colon and caecum | Right dorsal displacement of the large colon  Marked gas distension of colon and caecum | No |
| 13 | Gastrosplenic entrapment of the SI  No resection | Very poor motility at compromised SI  Resection and end to end jejuno-jejunal anastomosis | Yes |

**TABLE 3**: Prevalence and short-term outcome of cases according to severity and duration of colic signs, presenting heart rate, pre-operative reflux, blood lactate and primary lesion location and likelihood of mortality prior to discharge

|  |  |  |
| --- | --- | --- |
| Variable | n | Mortality prior to discharge |
|
| Severity of Colic Signs  Non-specific Signs  Mild Colic  Severe Colic | 15  5  12 | 46.7% (7/15)  40.0% (2/5)  41.7% (5/12) |
| Duration of Clinical Signs  prior to Referral  <12 hours  12-72 hours  >72 hours | 8  13  9 | 50.0% (4/8)  30.8% (4/13)  55.6% (5/9) |
| Presenting Heart Rate  <44 bpm  48-70 bpm  >70 bpm | 5  18  10 | 20.0% (1/5)  55.6% (10/18)  40.0% (4/10) |
| Pre-Operative  Nasogastric Reflux  Present  Not present | 11  14 | 36.4% (4/11)  35.7% (5/14) |
| Presenting Blood Lactate  ≤2 mmol/L  >2 mmol/L | 4  12 | -  50.0% (6/12) |
| Primary Lesion Location  Stomach  Small Intestine  Large Colon  Caecum  Multiple lesions without obvious origin | 2  14  13  2  2 | 100% (2/2)  35.7% (5/14)  30.8% (4/13)  100% (2/2)  100% (2/2) |
| Post-Operative Complications  Ileus  Colic  Incisional complications  Hyperlipaemia  Catheter associated  2nd Laparotomy  Other complications | 6  5  6  12  5  6  11 | 50.0% (3/6)  60.0% (3/5)  33.3% (2/6)  33.3% (4/12)  60.0% (3/5)  33.3% (2/6)  45.5% (5/11) |

**References**

1. Edwards, G., *Equine colic‐the decision for surgery.* Equine Veterinary Education, 1991. **3**(1): p. 19-23.

2. Mair, T. and B. Edwards, *Medical treatment of equine colic.* In Practice, 1998. **20**(10): p. 578-584.

3. Cox, R., et al., *Demographics, management and health of donkeys in the UK.* Veterinary Record, 2010. **166**(18): p. 552-556.

4. FAO, *FAOSTAT, Production Data, Live Animals*, in *Food and agriculture data for over 245 countries and territories*. 2007-2020: Food and Agriculture Organization of the United Nations.

5. Fernandez, E.B., et al., *Demography, preventative healthcare and reason for relinquishment of donkeys to an equine charity in the UK (2013‐2015).* Equine Veterinary Journal, 2021. **53**(2): p. 324-330.

6. Hillyer, M., F. Taylor, and N. French, *A cross‐sectional study of colic in horses on Thoroughbred training premises in the British Isles in 1997.* Equine veterinary journal, 2001. **33**(4): p. 380-385.

7. Cox, R., et al., *Case control study to investigate risk factors for impaction colic in donkeys in the UK.* Preventive veterinary medicine, 2009. **92**(3): p. 179-187.

8. Phillips, T. and J. Walmsley, *Retrospective analysis of the results of 151 exploratory laparotomies in horses with gastrointestinal disease.* Equine veterinary journal, 1993. **25**(5): p. 427-431.

9. Mair, T. and L. Smith, *Survival and complication rates in 300 horses undergoing surgical treatment of colic. Part 1: short‐term survival following a single laparotomy.* Equine veterinary journal, 2005. **37**(4): p. 296-302.

10. Freeman, D., et al., *Short‐and long‐term survival and prevalence of postoperative ileus after small intestinal surgery in the horse.* Equine Veterinary Journal, 2000. **32**(S32): p. 42-51.

11. Freeman, D., *Fifty years of colic surgery.* Equine veterinary journal, 2018. **50**(4): p. 423-435.

12. Southwood, L., T. Gassert, and S. Lindborg, *Colic in geriatric compared to mature nongeriatric horses. Part 1: Retrospective review of clinical and laboratory data.* Equine veterinary journal, 2010. **42**(7): p. 621-627.

13. Curtis, L., et al., *Prospective study of the primary evaluation of 1016 horses with clinical signs of abdominal pain by veterinary practitioners, and the differentiation of critical and non-critical cases.* Acta Veterinaria Scandinavica, 2015. **57**(1): p. 1-12.

14. Puotunen‐Reinert, A., *Study of variables commonly used in examination of equine colic cases to assess prognostic value.* Equine veterinary journal, 1986. **18**(4): p. 275-277.

15. Van Der Linden, M.A., C.M. Laffont, and M.M.S. van Oldruitenborgh‐Oosterbaan, *Prognosis in equine medical and surgical colic.* Journal of Veterinary Internal Medicine, 2003. **17**(3): p. 343-348.

16. Reeves, M., et al., *Development and validation of multivariable models to predict the need for surgery and prognosis in equine colic patients.* Acta Veterinaria Scandinavica. Supplementum, 1988. **84**: p. 329-332.

17. Proudman, C., et al., *Modelling long‐term survival of horses following surgery for large intestinal disease.* Equine veterinary journal, 2005. **37**(4): p. 366-370.

18. Proudman, C., et al., *Pre-operative and anaesthesia-related risk factors for mortality in equine colic cases.* The veterinary journal, 2006. **171**(1): p. 89-97.

19. Parry, B., G. Anderson, and C. Gay, *Prognosis in equine colic: a study of individual variables used in case assessment.* Equine veterinary journal, 1983. **15**(4): p. 337-344.

20. Delesalle, C., et al., *Determination of lactate concentrations in blood plasma and peritoneal fluid in horses with colic by an Accusport analyzer.* Journal of veterinary internal medicine, 2007. **21**(2): p. 293-301.

21. Pascoe, P., et al., *Mortality rates and associated factors in equine colic operations—a retrospective study of 341 operations.* The Canadian Veterinary Journal, 1983. **24**(3): p. 76.

22. Mair, T. and L. Smith, *Survival and complication rates in 300 horses undergoing surgical treatment of colic. Part 2: short‐term complications.* Equine veterinary journal, 2005. **37**(4): p. 303-309.

23. Burden, F., et al., *Hyperlipemia in a population of aged donkeys: description, prevalence, and potential risk factors.* Journal of veterinary internal medicine, 2011. **25**(6): p. 1420-1425.

24. Reid, S. and S.J. Cowan, *Risk factors associated with hyperlipaemia in the donkey.* Equine Veterinary Education, 1995. **7**(1): p. 22-24.

25. Mair, T. and L. Smith, *Survival and complication rates in 300 horses undergoing surgical treatment of colic. Part 4: Early (acute) relaparotomy.* Equine veterinary journal, 2005. **37**(4): p. 315-318.

26. Findley, J., et al., *Factors associated with survival of horses following relaparotomy.* Equine veterinary journal, 2017. **49**(4): p. 448-453.

27. McCarthy, R. and D. Hutchins, *Survival rates and post‐operative complications after equine colic surgery.* Australian veterinary journal, 1988. **65**(2): p. 40-43.

28. Thoefner, M., et al., *Factor analysis of the interrelationships between clinical variables in horses with colic.* Preventive Veterinary Medicine, 2001. **48**(3): p. 201-214.