UDC 619:616.34-009.74:636.1
SRSTI 68.41.45
DOI: 10.52269/22266070_2023_2_37

PROGNOSTIC VALUE OF PHYSIOLOGICAL PARAMETERS IN EQUINE COLIC PATIENTS

Zoja Mikniene – Lithuanian University of Health Science (LUHS), Veterinary Academy (VA), Large Animal Clinic, Kaunas, Lithuania.

Indre Mickeviciene – Veterinarian/veterinary pharmacist, UAB VET-1, Kaunas, Lithuania.

Elvina Apulskyte – The Grove referrals Veterinary Hospital and Clinics, Fakenham, Great Britain.

Donata Mikalauskienė – Lithuanian University of Health Science (LUHS), Veterinary Academy (VA), Large Animal Clinic, Kaunas, Lithuania.

The article describes the results of a study of 46 heads of horses with colic syndrome at the veterinary clinic of the Lithuanian University of Medical Sciences in the period from 2016 to 2018. Upon arrival, anamnesis, condition of horses and duration of colic syndrome were recorded. During the clinical examination, 9 physiological parameters were recorded: temperature, heart rate, capillary filling time, mucosal color, respiratory rate, gastrointestinal noises, gastric reflux, digital pulse and volume of packed cells.

All animals were divided into 2 groups: survivors and non-survivors. After that, the 9 physiological parameters described above were compared in two groups to determine their significant prognostic value for the survival of horses.

Nine variables were used in the Cox proportional risk model. The odds ratio and the corresponding confidence interval were obtained.

The paper shows the results of the survival rate of horses, taking into account the sexual trait. The causes of the appearance of colic syndrome are analyzed. The most important physiological parameters in relation to the appearance, course and completion of colic syndrome have been identified.

Key words: colic, outcome, equine, physiological parameters.

ПРОГНОСТИЧЕСКОЕ ЗНАЧЕНИЕ ФИЗИОЛОГИЧЕСКИХ ПАРАМЕТРОВ У ЛОШАДЕЙ С КОЛИКАМИ

Зоя Микниене – Литовский университет медицинских наук (LUHS), Ветеринарная академия (VA), Крупная ветеринарная клиника, Каунас, Литва.

Индре Мицкявичене – ветеринар/ветеринарный фармацевт, UAB VET-1, Каунас, Литва.

Эльвина Апульските – Ветеринарная больница и клиники Grove , Fakenham, Великобритания.

Доната Микалаускене – Литовский университет медицинских наук (LUHS), Ветеринарная академия (VA), Крупная ветеринарная клиника, Каунас, Литва.

В данной статье описаны результаты исследования 46 голов лошадей с синдромом колик на базе крупной ветеринарной клиники Литовского университета медицинских наук в период с 2016 по 2018 годы. По прибытию животных в клинику были записаны анамнез, состояние лошадей и продолжительность синдрома колик. Во время клинического обследования зарегистрированы 9 физиологических параметров животных: температура, частота сердечных сокращений, время наполнения капилляров, цвет слизистой оболочки, частота дыхания, желудочно-кишечные шумы, желудочный рефлюкс, цифровой пульс и объем упакованных клеток.

Все животные были разделены на 2 группы: выжившие и не выжившие. После чего сравнивали у двух групп 9 вышеописанных физиологических параметров, для выяснения их значительной прогностической ценности для выживаемости лошадей.

В модели пропорционального риска Кокса использовались девять переменных. Были получены отношение шансов и соответствующий доверительный интервал.

В работе показаны результаты выживаемости лошадей с учетом полового признака. Проанализированы причины появления синдрома колик у лошадей. На основе результатов исследования выявлены наиболее важные физиологические параметры в отношении появления, течения и завершения синдрома колик.

Ключевые слова: колики, исход, лошадь, физиологические параметры.

ЖЫЛҚЫ КОЛИКІМЕН АУЫРАТЫН НАУҚАСТАРДАҒЫ ФИЗИОЛОГИЯЛЫҚ ПАРАМЕТРЛЕРДІҢ БОЛЖАМДЫҚ МӘНІ

Зоя Микниене – Литва денсаулық ғылымдары университеті (LUHS), ветеринарлық академия (VA), ірі Ветеринарлық клиника, Каунас, Литва.

Индре Мицкявичене – ветеринар / ветеринарлық фармацевт, UAB VET-1, Каунас, Литва.

Эльвина Апульските – Grove ветеринарлық ауруханасы мен клиникалары, Fakenham, Ұлыбритания.

Доната Микалаускене – Литва Медициналық ғылымдар университеті (LUHS), ветеринарлық академия (VA), ірі Ветеринарлық клиника, Каунас, Литва.

Бұл мақалада 2016-2018 жылдар аралығында Литва медицина ғылымдары университетінің ірі ветеринарлық клиникасының базасында колик синдромы бар 46 жылқының зерттеу нәтижелері сипатталған. Әрбір жануар клиникаға келгеннен кейін жылқылардың тарихы, жағдайы және колик синдромының ұзақтығы жазылды. Клиникалық тексеру кезінде колик синдромы бар жылқылардың тоғыз физиологиялық параметрлері тіркелді, атап айтқанда: температура, жүрек соғу жиілігі, капиллярларды толтыру уақыты, шырышты қабықтың түсі, тыныс алу жиілігі, асқазан-ішек шуы, асқазан рефлюксі, сандық Импульс және оралған жасушалардың көлемі.

Эксперимент кезінде барлық жануарлар екі топқа бөлінді: тірі қалғандар және тірі қалмағандар. Осыдан кейін екі топта жоғарыда сипатталған 9 физиологиялық параметр салыстырылды, олардың жылқылардың өмір сүруі үшін айтарлықтай болжамды мәнін анықтау мақсатында.

Коксты пропорционалды тәуекел моделінде тоғыз айнымалы қолданылды. Оның барысында коэффициент коэффициенті және тиісті сенімділік аралығы алынды.

Мақалада жыныстық белгіні ескере отырып, жылқылардың өмір сүру нәтижелері көрсетілген. Жылқылардағы колик синдромының себептері талданды. Зерттеу нәтижелеріне сүйене отырып, колик синдромының пайда болуына, ағымына және аяқталуына қатысты ең маңызды физиологиялық параметрлер анықталды.

Түйінді сөздер: колик, Мысырдан шығу, жылқы, физиологиялық параметрлер.

Colic syndrome is one of the most common causes of death in horses [1, p. 4]. It is reported that 4 out of 100 horses are diagnosed with colic syndrome each year [2, p. 98]. Colic can be related to gas accumulation, sand and feed impactions, enteroliths, internal organ displacements or strangulations of intestines. A thorough collection of patient history, clinical examination and laboratory testing have been shown to provide a helpful basis for directing risks and assessing chances of survival in colic cases. However, an in-depth investigation of the gastrointestinal tract is needed in order to confirm the initial diagnosis and appoint an appropriate treatment for each patient respectively [1, p. 3].

Physiological parameters of the cardiovascular system, such as heart rate, colour of mucous membranes and capillary refill time, rectal temperature, respiratory rate, gastrointestinal tract sounds and digital pulse are important for the evaluation of colic horse. Results of additional diagnostic tests such as packed cell volume should be also considered in decision regarding the treatment options and predicting the disease outcome [2, p. 97].

Changes in clinical parameters which include elevated heart rate, increased rectal temperature, pale or cyanotic mucous membranes, increased capillary refill time, and decreased or absent abdominal motility are indicative of poor prognosis, severe conditions and higher mortality rate in colic horses [3, p. 95].

The aim of this study is to analyse the prognostic value of physiologic parameters in horses diagnosed with colic syndrome.

Materials and Methods

This study included 46 horses submitted for colic syndrome to Large Animal Clinic of Lithuanian University of Health Science (LUHS) in 2016 – 2018 years. Soon after arrival, anamnesis and state of horses and duration of colic syndrome signs were recorded Physiological parameters as temperature, heart rate, capillary refill time, mucous membrane colour, respiratory rate, gastrointestinal sounds, gastric reflux, digital pulse, and packed cell volume were recorded during the clinical examination.

All 46 horses were divided into two groups: survivors and non-survivors. All 46 horses were divided into two groups: survivors and non-survivors and nine physiological parameters were assessed in these two groups. Temperature was evaluated as high (>39℃) and low (≤39℃). Heart rate was assessed as: high (more than 60 beats per minute) or low (less than 60 beats per minute). Capillary refill time was classified as less than 2 seconds or more than 2 seconds. Mucous membrane color was described as normal or pale/cyanotic. Respiratory rate was assessed as high (more than 16 breaths per minute) or low (less than 16 breaths per minute). Gastrointestinal sounds were classified by auscultation as: present and normal (> 2 spots) or reduced and absence (≤ 2 spots) for each abdominal quadrant. The presence or absence of gastric reflux and digital pulsation were determined. Clinicopathological variable as packed cell volume was described as high (>50%) or low (≤50%).

All 9 physiological parameters were compared between survivors and non – survivors to elucidate their significant prognostic value on equine survival. *Microsoft Office Excel 2010* and *Microsoft Office Word 2010* were used for the research work. In this study analysis of obtained information was performed by IBM SPSS Statistics (version 27.0). Nine variables were used in a Cox proportional hazard model. The odds ratio and the corresponding confidence interval were received. The results were considered statistically significant when $P < 0,05$.

Results

In this study, the overall survival rate was 63% (29/46). The research group consisted of 54% stallions (25/46) and 46% mares (21/46). Large colon constipation and internal organs displacement (both 17%), also necrotizing enterocolitis, gastric ulcer and distention (9% each) were the most commonly causes of colic syndrome.

Some physiological indicators have not been established for several horses, therefore the number of horses varies (Table 1). For instance, heart rate was measured for all 46 horses, meanwhile capillary refill time was counted for 37 of 46 horses (80%). Heart rate (P<0.001), capillary refill time (P<0.013), gastrointestinal sounds (P<0.002), gastric reflux (P<0.001) were significant for equine survival. Packed cell volume (PCV) was also significant (P<0.001). Respiratory rate, rectal temperature, appearance of mucous membranes and digital pulse were not significant for patients survival.

Table 1 – Predictor factors of death by Cox regression analysis in 46 horses

Variables	***P***	**OR***	**95% CI**
Heart rate	<.001	11.45	2.68-48.86
Respiratory rate	.338	2.29	0.59-8.78
Rectal temperature	.547	3.50	0.28-42.76
Gastrointestinal sounds	.002	9.06	2.10-39.02
Gastric reflux	<.001	27.00	2.94-247.48
Capillary refill time	.013	11.91	1.33-106.72
Mucous membrane color	.510	1.81	0.48-6.76
Digital pulsation	.070	4.27	1.00-18.28
Packed cell volume	.001	10.54	2.46-45.16
*As odds ratio increases, risk of mortality increases.			

A colic horse with the heart rate of over 60 beats per minute had 11.45 times more chances to have a fatal prognosis (30% non-survivors versus 13% with low heart rate) (Table 2).

Table 2 – Number of non-survival and survival horses in colic by clinical and laboratory variables 2016-2018

Variable	**Non – survivors (%)**	**Survivors (%)**
Heart rate (n=46)		
high	30	9
low	13	54
Respiratory rate (n=46)		
high	28	37
low	9	26
Rectal temperature (n=36)		
high	6	3
low	33	58
Gastrointestinal sounds (n=46)		
≤ 2 spots	35	22
> 2 spots	7	37
Gastric reflux (n=42)		
is	21.43	2.38
none	19.05	57.14
Capillary refill time (n=37)		
> 2 sec	30	32
≤ 2 sec	3	35
Mucous membrane color (n=40)		
pale/cyanotic	20	28
normal	15	38
Digital pulsation (n=42)		
is	17	10
none	21	52
Packed cell volume (n=42)		
high	26	10
low	14	55
n – number of horses		

Results of patients with an increased capillary refill time demonstrated an 11.91 times greater tendency for death (30% non-survivors with more than 2 seconds and 3% with less than 2 seconds). The horses presenting absence of intestinal sounds were 9.06 times likely to die than those with the gut mobility (35% and 7%, respectively). The hazard ratio of gastric reflux was the highest of all measured parameters ratio. The colic patients with gastric reflux were 27 times more likely to die compared with horses without reflux. In this study, non-survivors with gastric reflux were 21% and without gastric reflux were 19% of 42 horses, respectively. Meanwhile, survivors with gastric reflux were 2% and without reflux were 57% of 42 colic horses. Colic horses with an increased packed cell volume have 10 times more chances to die (26% with an increased PCV versus 14% with low PCV).

Discussion

In this study, 46 horses were diagnosed with colic syndrome. The survival rate was 63% however, a large portion of colic patients died (28%; 13/46) or were euthanised (9%; 4/46). We aimed to find out whether the outcome of colic can be predicted based on deviations from physiological parameters. This study had several limitations. A few horses were not subjected to the full range of clinical examination The second limitation is the data regarding the cases of euthanised horses was insufficient to determine the causes of outcome of each case.

In our study, increased heart rate was significantly associated with a fatal prognosis for colic horses (P<0.001), consistent with other studies (4–7). Farrell with others determined that the highest percentage of non-survivors were reported to have an elevated heart rate (> 61 bpm) [4, p. 8]. Accordingly, in our study non-survivors with an increased heart rate were 30% (11/46) and survivors comprised only 9% (4/46). Based on the study findings, an increased heart rate could be identified as a parameter with a strong prognosis value in colic cases.

Capillary refill time was found to be significant (P<0.013) prognostic parameter, predicting the survival of colic horses. Meanwhile, in the other study capillary refill time with a value of ≥ 2 seconds was less significant (P=0.046)) [5, p. 12]. Nevertheless, 2014 study noted that this parameter is significant in critical cases (P=0.002) [6] and is more similar to our study results.

Numerous studies have reported that absence of gastrointestinal sounds even in ≥ 1 quadrant is a significant indicator for worst prognosis and critical cases had significantly diminished intestinal sounds compared to medical cases [6, p. 9; 5, p. 11]. Our study confirms these findings as the decreased gut motility was found to be a significant prognostic indicator in horses with colic syndrome. Equine patients with absence of gastrointestinal sounds are about 9 times more likely to die compared to the horses with gut sounds in all four quadrants.

According to other research, the presence of gastric reflux was a reliable significant predictor of survival. Gastric reflux more represented in non-charged groups than in others [9]. In our study, it was assessed that colic horses with gastric reflux are 27 times more likely to have fatal outcomes (P<0.001). For this reason, presence of reflux is able to be a prognostic parameter for critical cases in the treatment.

In some studies it is reported packed cell volume has significant prognostic value between surgical and medical cases. Packed cell volume was significantly increased in colic horses treated surgically than in those treated conservatively [8, p. 72; 7, p. 18]. Another study noted PCV as an advantageous variable to predict fatal prognosis for colic horses, on the contrary, this result was not significant in our study (P=0.2) [4]. In our research, packed cell volume is strongly significant (P<0.001) and horses with an increased PCV had 10 times more chances to have fatal prognosis than those with low or normal PCV. Comparing different results, packed cell volume can be a significant prognostic indicator predicting the outcome of colic syndrome.

In our study respiratory rate, rectal temperature, appearance of mucous membranes and digital pulsation were not significant for colic patients. 2014 study also noted there was no difference in respiratory reaction and rectal temperature between all outcome groups. [6]. Meanwhile, 2022 study reported respiration rate is a significant parameter for survival (P=0.01)(4). Another study noted that pale, slightly abnormal and cyanotic mucosal membranes significantly (P=0.001, P=0.005 and P=0.024, respectively) increased chances for fatal outcome in colic horses [9, p. 8].

Conclusions

Physiological parameters such as increased heart rate, presence of gastric reflux, absence of gut sounds, increased capillary refill time, and higher packed cell volume appeared to be relevant predictors of the fatal outcome. In our study, heart rate and gastric reflux were the most significant parameters. However, more research for physiological indicators such as respiratory rate, digital pulsation, rectal temperature and appearance of mucous membranes to find out their prognostic value for colic horses survival is needed

Acknowledgements

This publication has been sponsored by Lithuanian University of health science, Kaunas, Lithuania.

REFERENCES:

1. **Ferraro GL. Colic: An Age-Old Problem** [Elektronnyj resurs]/ GL.Ferraro// Ceh Horse Rep. 2008;26(1):4. Available from: http://www.vetmed.ucdavis.edu/ceh/docs/horsereport/pubs-HR26-1-bkm-sec.pdf.

2. **Cook VL, Hassel DM. Evaluation of the Colic in Horses. Decision for Referral** [Elektronnyj resurs]/ VL.Cook, DM.Hassel // Vet Clin North Am – Equine Pract. 2014;30(2):383–98. Available from: http://dx.doi.org/10.1016/j.cveq.2014.04.001.

3. **Bihonegn Temesgen and Bekele Fasika. Colic in Equine: A Review Article** [Text] / B.Temesgen, B.Fasika //Int J Adv Res Biol Sci. 2018;5(5):185 – p.95.

4. **Farrell A, Kersh K, Liepman R, Dembek KA. Development of a Colic Scoring System to Predict Outcome in Horses** [Text] / A.Farrell, K.Kersh, R.Liepman, KA.Dembek// Front Vet Sci. 2021;8(October): p.1–8.

5. **Curtis L, Burford JH, Thomas JSM, Curran ML, Bayes TC, England GCW, 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** [Text] / L.Curtis, JH.Burford, JSM.Thomas, ML.Curran, TC.Bayes// Acta Vet Scand. 2015;57(1): p.1–12.

6. **Jennings KM, Curtis L, Burford JH, Freeman SL. Prospective survey of veterinary practitioners' primary assessment of equine colic: Clinical features, diagnoses, and treatment of 120 cases of large colon impaction** [Text] / KM.Jennings, L.Curtis, JH.Burford, SL.Freeman// BMC Vet Res. 2014;10(Suppl 1): p.1–10.

7. **Straticò P, Varasano V, Palozzo A, Guerri G, Celani G, Revelant O, et al. Retrospective Study on Risk Factors and Short-Term Outcome of Horses Referred for Colic from 2016 to 2022** [Text] / P.Straticò, V.Varasano, A.Palozzo, G.Guerri, G.Celani, O.Revelant// Vet Sci. 2022;9(10):p.1–19.

8. **Kos VK, Kramaric P, Brloznik M. Packed cell volume and heart rate to predict medical and surgical cases and their short-term survival in horses with gastrointestinal-induced colic** [Text] / VK.Kos, P.Kramaric, M.Brloznik// Can Vet J. 2022;63(4):365 – p.72.

9. **Wormstrand BH, Ihler CF, Diesen R, Krontveit RI. Surgical treatment of equine colic – a retrospective study of 297 surgeries in Norway 2005-2011** [Text] / BH.Wormstrand, CF.Ihler, R.Diesen, RI.Krontveit// Acta Vet Scand. 2014;56(1):12. p.8.

Information about authors:

Zoja Mikniene – Lithuanian University of Health Science (LUHS), Veterinary Academy (VA), Large Animal Clinic, Kaunas, Lithuania, phone: +37061029223; e-mail: zoja.mikniene@lsmu.lt.

Indre Mickeviciene – Veterinarian/veterinary pharmacist, UAB VET-1, Kaunas, Lithuania; Lithuanian University of Health Science (LUHS), Veterinary Academy (VA), Large Animal Clinic, Kaunas, Lithuania, e-mail: indre.bart56@gmail.com.

Elvina Apulskyte – The Gvove Veterinary Hospital and Clinics, Fakenham, Great Britain, e-mail: donata.mikalauskiene@lsmu.lt.

Donata Mikalauskienė – Lithuanian University of Health Science (LUHS), Veterinary Academy (VA), Large Animal Clinic, Kaunas, Lithuania, e-mail: eelvinaa@gmail.com.

Зоя Микниене – Литовский университет медицинских наук (LUHS), Ветеринарная академия (VA), Крупная ветеринарная клиника, Каунас, Литва, телефон phone: +37061029223; e-mail: zoja.mikniene@lsmu.lt.

Индре Мицкявичене – ветеринар/ветеринарный фармацевт, UAB VET-1, Каунас, Литва; Литовский университет медицинских наук (LUHS), Ветеринарная академия (VA), Клиника крупных животных, Каунас, Литва, e-mail: indre.bart56@gmail.com.

Эльвина Апульскайте – Ветеринарная больница и клиники Gvove, Fakenham, Великобритания, e-mail: donata.mikalauskiene@lsmu.lt.

Доната Микалаускене – Литовский университет медицинских наук (LUHS), Ветеринарная академия (VA), Крупная ветеринарная клиника, Каунас, Литва, e-mail: eelvinaa@gmail.com.

Зоя Микниене – Литва денсаулық ғылымдары университеті (LUHS), ветеринарлық академия (VA), ірі Ветеринарлық клиника, Каунас, Литва, телефон: +37061029223; e-mail: zoja.mikniene@lsmu.lt.

Индре Мицкявичене-ветеринар / ветеринарлық фармацевт, UAB VET-1, Каунас, Литва; Литва денсаулық ғылымдары университеті (LUHS), ветеринарлық академия (VA), ірі жануарлар клиникасы, Каунас, Литва, e-mail: indre.bart56@gmail.com.

Эльвина Апульскайте-Gvove ветеринарлық ауруханасы мен клиникалары, Fakenham, Ұлыбритания, e-mail: donata.mikalauskiene@lsmu.lt.

Доната Микалаускене – Литва Медициналық ғылымдар университеті (LUHS), ветеринарлық академия (VA), ірі Ветеринарлық клиника, Каунас, Литва, e-mail: eelvinaa@gmail.com.