

Clinical Manifestations and Audio Frequencies for True Equine Colic Cases of Nineveh Governorate Horses

Mahmood Khayri Ali Al-Dulaymi ¹, Osamah Muwaffag Abdul-Jabbar Al-Iraqi ².

1-Veterinary Hospital in Nineveh, Veterinary Directorate, Mosul, Iraq.

2-Department of Internal and Preventive Medicine, College of Veterinary Medicine, University of Mosul, Mosul, Iraq.

Corresponding Author Email Address: mahmood.22vmp34@student.uomosul.edu.iq

ORCID ID: <https://orcid.org/0000-0001-7846-0873>

DOI: <https://doi.org/10.23975/bjvr.2024.152160.1122>

Received: 25 July 2024 **Accepted:** 25 August 2024.

Abstract

The study included an examination of 50 local horses in different areas of Nineveh Governorate for the period starting from 1/7/2023 to 1/4/2024. The first group included 40 animals that showed signs of colic, and the second group consisted of 10 clinically healthy animals that were considered a control group and were older than six months for both sexes. A clinical examination was conducted, which included recording the history of the animal's medical history condition and, symptoms, and clinical manifestations, including as well as measuring (body temperature, heart rate, respiratory rate, examining the mucous membranes of the eyes, capillary refilling time in the lower lip, and examining skin elasticity). The colicky horses' breathing rate went up by 21 cycles per minute, their heart rate by 56 beats per minute, their capillary refilling time went up by 3 seconds, and their skin fold test rate went up by 3.7 seconds compared to the healthy controls. The sound frequency went up when auscultating from both sides of the abdomen; it was 272.5 Hz from the left side and 249 Hz from the right side. There was a significant difference from the left side compared to the healthy horses, and the sound repetition rate went up by 5 times per minute. It has been concluded that an electronic stethoscope could be a more accurate tool for examining colicky horses.

Keywords: horses, colic, symptoms, sound analysis

Introduction

Colic in horses is considered a serious medical condition. It must be dealt with immediately because it may indicate serious severe digestive or non-digestive problems that threaten the animal's life (1). Colic cases in horses are also characterized by the fact that they may develop quickly and require immediate medical intervention. If colic is not treated quickly, it can lead to a deterioration in the horse's health condition and even to death in some cases. Therefore, horse owners and those interested in equestrianism must be aware of the signs of colic and its causes, Nonetheless to have the ability to deal with this condition effectively, whether through early detection and rapid medical intervention or proper prevention and care measures to maintain horses health (1,2).

Colic is a painful or uncomfortable sensation in the abdominal area, and it can be caused by several different causes, such as impaction, neoplasm, displacement, functional, and infectious (3). Colic is characterized by contractions or spasms in the intestines or digestive system. It may be accompanied by a sign of bloating, nausea, constipation, or diarrhea, or it may be from another source within the abdominal cavity, such as the animal's urinary system or reproductive systems. The degree of pain also varies from mild, moderate, severe, and recurrent and may be chronic, depending on its cause and severity (4,5).

Electronic stethoscopes offer many advantages over traditional acoustic stethoscopes, including noise reduction,

increased amplification, and the ability to store and transmit sounds. However, the sound properties of electronic and medical stethoscopes can differ significantly (6). Computerized recording and sound analysis have also been shown to be superior to conventional auscultation in clinical settings in many medical conditions (7). The study aimed to assess pain severity by facial expressions and clinical examination, determine the severity of disease using electronic acoustic analysis, and identify the best locations for electronic auscultation screening.

Materials and Methods

Study animals: The study examined 50 local horse breeds in different areas of Mosul Governorate. They were divided into two groups according to the Case Control Study method: the first group included 40 animals showing signs of different forms of colic, and the second group included 10 clinically healthy animals served as the control group. Animals of both groups are aged more than six months and of both sexes.

Clinical examinations: Clinical examination of both horse groups was applied, including, taken animal history, and examining the vital signs, including body temperature, respiratory, and heart rate. Moreover, ocular mucus membranes, capillary refilling time, and skin fold test were also examined according to (3).

Auscultation of abdomen: Abdominal clinical examination was applied according to (8) using the FLASH Technique in seven specific topographic locations: (1) the

ventral side of the abdomen, (2) the gastric window, (3) the renal-splenic window, (4) the left middle third of the abdomen, (5) the duodenal window, (6) right middle third of the abdomen, (7) thoracic window.

Determine the comfort level of the animal: The animal's comfort level was determined based on (9), As the scale consists from (0-4) , the higher the number, the greater the stress on the animal, as shown in (Figure).

Examination by auscultation: Auscultation was examined using a stethoscope on both sides of the animal to detect normal and abnormal sounds in several locations from

the upper and lower abdomen and on both the right and left sides of the animal's body.

Electronic auscultation and sound analysis: Sounds were recorded in the abdominal area of healthy horses and horses showing signs of colic using an electronic stethoscope (CloudSteth Company / China) (figure 2) at the same auscultation sites as the traditional stethoscope. The sounds were then saved in an electronic memory on the hard disk to use them in analyzing the sounds using a digital program (WavePad Master Edition v19.11 Mar. 19, 2024) based on multi-resolution acoustic wave analysis and displaying it in the form of wavelengths according to the method (9,10).

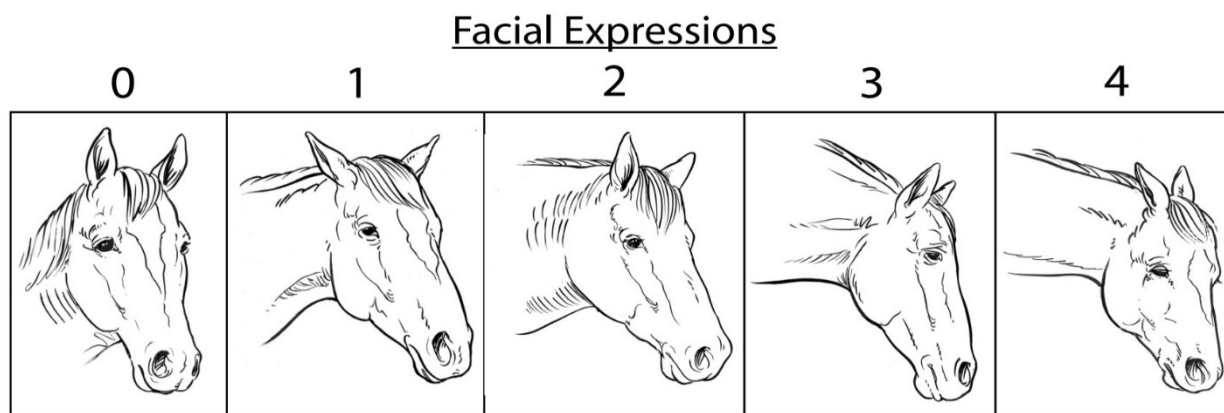


Figure (1): The animal's comfort level.



Figure (2): The Cloudsteth (electronic stethoscope).

Results

The results of the study showed that there was a significant difference between the control group and the colicky group through expressing their colic by examining their facial expressions at ($P \leq 0.05$), as shown in Table (1) and Figure (3). Results also showed a significant ($P \leq 0.01$) increase in body temperature, heart and respiratory rate, capillary refilling time, and skin fold test in colicky horses than in the control group. Table (2). The (WavePad Sound Editor) program was used to calculate sound frequencies. The sounds were heard and then recorded using the electronic stethoscope in the left, right, and right regions of the abdomen. There was a

significant difference in the sound frequency for auscultation from the left side, as the frequency was higher in horses suffering from colic, where it reached (272.5 Hz) compared to normal horses whose frequency value reached (239 Hz), with a significant difference between the two groups at a significant level ($P \leq 0.01$). As for the sound frequency for auscultation from the right side, there was a slight increase in the number of horses that suffered from colic when compared to normal horses, but this increase was not significant. Concerning measuring the rate of sound repetition per minute, it was found that sound repetition increased significantly in horses suffering from colic compared to normal horses at a significant level ($P \leq 0.01$), as in Table (3).

Table (1): A scores for evaluating facial expression in colicky horses and control group.

Groups	Grades (number of horses in group=50)
	Median (IQR: Inter-Quartile-Range)
Control group	B (0) 0
Colicky group	(2) 2A
Probability level (P-value)	$P < 0.001$

Numbers represent median scores (IQR: Inter-Quartile-Range) Kruskal-Wallis test. Different letters mean that there is a significant difference between the groups at a probability level less than ($P \leq 0.05$).

Table (2): Mean Measurements of Vital signs of colicky horses and control group.

Item	Mean $\pm$ standard error		P-value
	Control group n=10	Colicky horses n=40	
Heart rate (beats/minute)	34.25 ± 0.7	56 ± 6.0	0.01
Respiratory rate (cycles/min.)	11.62 ± 1.0	21 ± 3.4	0.01
Capillary refill time (second)	1.1 ± 0.1	3 ± 0.3	0.01
Skin fold test/ sec.	1.43 ± 0.1	3.7 ± 0.3	0.01
Body temperature ($^{\circ}\text{C}$)	37.6 ± 0.1	37.7 ± 0.3	0.67

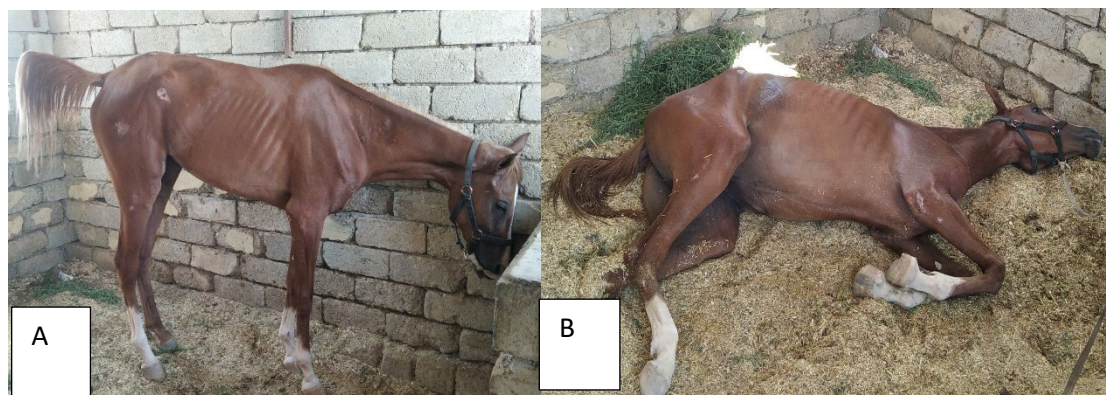


Figure (3): Clinical Signs of a horse suffering from colic. (A): The Figure expresses depression of degree (4) facial expressions in colic horse. (B): Lateral recumbence, which means severe abdominal pain.

Table (3): Sound frequencies recorded using the electronic stethoscope from the left and right sides of the abdomen and sound repetition rate.

Item	Means $\pm$ standard error		P-value
	Normal Horses n=10	Colicky horses n=40	
Sound frequencies for auscultation from the left side (Hz)	239 $\pm$ 27	272.5 $\pm$ 31	0.01
Sound frequencies for auscultation from the right side (Hz)	238 $\pm$ 27	249 $\pm$ 28	0.44
Sound repetition rate/min.	1.1 $\pm$ 0.02	5 $\pm$ 3.0	0.01

Discussion

This study's results were identical to those related to facial expressions, as reported in other studies, which had significant differences when comparing a group of control horses with a group of colicky horses. This finding agrees with (12), who stated that facial expressions in horses vary from one animal to another depending on the severity of the disease, pain, and type. This is also affected by the pain threshold, and understanding these expressions is an important part of horse care, as good

observation of these signs can help diagnose and treat potential health problems, including pain and injuries (13,14). The presence of these signs may be due to spasms and tension in the muscles around the face, the facial muscles themselves, and the jaw muscles (15). Heart rate in colicky horses can be affected by several factors, including the severity of the pain, the condition of the horse, and the surrounding conditions. However, a horse's normal resting heart rate is around 28-44 beats per minute (16,17). However, when a horse faces a health problem such as colic, the

heart rate may rise, perhaps significantly, as was shown in the results of this study, where a significant difference was recorded between the control group and the group of horses that suffered from colic, as this study agreed with (17,18). This increase is caused by pain and anxiety in the animal.

A significant difference was also recorded in the increase in the respiratory rate in horses that suffered from colic compared to normal horses in the control group, and this result agreed with (18,19) due to muscle tension and increased pain, which leads to short and rapid breathing rates.

The results of the current study are consistent with what was reported by (20,21), where an increase in the filling time of the capillaries was recorded in horses that suffered from colic compared to control horses, and that colic can cause an increase in the filling time of the capillaries. Capillary blood vessels become full due to muscle spasms and intestinal contractions, which leads to a lack of blood and oxygen supply to the blood vessels, thus increasing the chances of permanent tissue damage.

This study was similar to what was stated in previous studies, where significant differences were recorded in the tests conducted on the skin fold between the control group and the group of horses that suffered from colic, as both (22,23) described that the skin fold test in horses suffering from colic is of great importance, especially in cases of dehydration, for the horses, especially in comparison with other animals, as the time for the skin folds to return was measured as moderate dehydration if the skin fold returned within a period of 2-4 seconds, while horses are

considered to have moderate dehydration if the skin fold retraction rate is within 4-8 seconds and severe when the skin fold retraction rate is within 8-12 seconds. The skin may be described as lacking in softness; in some cases, it is wrinkled, and the hair is rough, devoid of shine, and broken. In this study, signs of dehydration were found in varying degrees, depending on the severity of the colic suffered by the colic animal. The greater the severity of the pain, the greater the severity of the dehydration. This is explained by the severity of the pain, which increases muscle stress and tension in the affected animal, as well as the animal's abstention from eating and drinking for long periods. (24).

The examination results showed an increase in sound frequency when auscultating the abdominal wall from the left side of horses suffering from colic compared to normal horses, and the difference was significant. This result is consistent with (25). The increase frequency of sounds also indicates the severity of the medical condition. The more the medical condition increases in some cases of colic due to gas, drinking large amounts of cold water, or irritation of the digestive system, leads an increase in the sound frequencies, and the reason is that most parts of the small intestine, which is located in the left part of the abdomen, close to the abdominal wall (26,27). While there was no significant difference when auscultating from the right side, the reason is that most parts of the small intestine are located on the left side of the abdomen, which moves faster and more than the large intestine (28). It was also noted that there

was a significant increase in the rate of sound repetition per minute in horses that suffered from colic compared to normal horses, and the reason for this is due to the overlapping neural, muscular, and hormonal effects (26,29). Disruption of this complex of neural, muscular, and hormonal interaction leads to stagnation of the movement of nutrients, and this condition is also called ileus.

Conclusion

We conclude from this study that the frequency of sound increases on the left side in cases of colic more than on the right side. Initial clinical examinations and facial expressions give an initial estimate of the severity of the colic and the possibility of using auscultation and electronic sound analysis to diagnose colic cases in horses.

Conflicts of interest

The authors declare that there is no conflict of interest.

Ethical Clearance

This work is approved by The Research Ethical Committee.

References

1. Albanese V, Munsterman A, Klohn A. (2022). Prevalence of Gastric Ulceration in Horses with Enterolithiasis Compared with Horses with Simple Large Intestinal Obstruction. *Veterinary Sciences. Vet. Sci.* 9(11):587.
2. Bowden A, Burford JH, Brennan ML, England GCW, Freeman SL. (2020). Horse owners' knowledge, and opinions on

recognizing colic in the horse. *Equine Veterinary Journal.* 52(2):262–7.

3. Constable PD, Hinchcliff KW, Done SH, Grünberg W. (2017). *Veterinary medicine: a textbook of the diseases of cattle, horses, sheep, pigs, and goats.* Edition 11. St. Louis, Missouri: Elsevier; Pp 220-286. DOI: [10.1016/B978-0-7020-52460.00027-9](https://doi.org/10.1016/B978-0-7020-52460.00027-9).

4. Archer DC, Pinchbeck GL, Proudman CJ, Clough HE. (2006). Is equine colic seasonal? Novel application of a model-based approach. *BMC Vet Res.* 2(1):27.

5. Hajimohammadi A, Ghane M, Ghari Tehrani M, Paravar B, Mirzaei A, Razavi S, (2023). Association of the severity of colic in horses with oxidative stress biomarkers, acute-phase proteins, and certain trace elements. *JES.* 34(3):73–81.

6. Rennoll V, McLane I, Emmanouilidou D, West J, Elhilali M. (2021). Electronic Stethoscope Filtering Mimics the Perceived Sound Characteristics of Acoustic Stethoscope. *IEEE J Biomed Health Inform.* 25(5):1542–9.

7. Kevat AC, Kalirajah A, Roseby R. (2017). Digital stethoscopes compared to standard auscultation for detecting abnormal paediatric breath sounds. *Eur J Pediatr.* 176(7):989–92.

8. Busoni V, Busscher VD, Lopez D, Verwilghen D, Cassart D (2011). Evaluation of a protocol for fast localised abdominal sonography of horses (FLASH) admitted for colic. *The Veterinary Journal.* 188(1):77–82.

9. Er C, Demir PA, Ok M. (2020). Prevalence and Cost of Colic Cases in Sport Horses in Turkey. *IJVAr*, 3 (2): 29-33.
10. Kalinauskienė E, Razvadauskas H, Morse DJ, Maxey GE, Naudžiūnas A. (2019). A Comparison of Electronic and Traditional Stethoscopes in the Heart Auscultation of Obese Patients *Medicina*. 5;55(4):94.
11. Munir S, Endiyono E. (2021). Design and development of electronic stethoscope for auscultation. *Medisians*. 6;19(2):53.
12. Tomberg C, Petagna M, De Selliers De Moranville LA. (2023). Horses (*Equus caballus*) facial micro-expressions: insight into discreet social information. *Sci. Rep.* 13(1):8625.
13. Kim SM, Cho GJ. (2023). Analysis of Various Facial Expressions of Horses as a Welfare Indicator Using Deep Learning. *Veterinary Sciences*. 10(4):283.
14. Ricci-Bonot C, Mills DS. (2023). Recognising the facial expression of frustration in the horse during feeding period. *Applied Animal Behaviour Science*. 265:105966.
15. Contino EK, Mama KR. (2015). Recognition of Pain. In: Robinson's Current Therapy in Equine Medicine. Elsevier. Pp. 49–54.
16. Chope KB. Cardiac/Cardiovascular Conditions Affecting Sport Horses (2018). *Veterinary Clinics of North America: Equine Practice*. 34(2):409–25.
17. Triguinho A, Fontes-Sousa AP, Pimenta J, Cotovio M. (2023). Electrocardiographic Reference Values in Clinically Healthy Lusitano Horses. *Veterinary Sciences*. 10(8):518.
18. Alsaad KM, Nori AA. (2010). Clinical, hematological and biochemical studies of colic syndrome in draught horses in Mosul. *The 14th Scientific congress, Assiut university, Faculty of veterinary medicine*.
19. Vitale V, Viu J, Armengou L, Ríos J, Jose-Cunilleras E. (2020). Prognostic value of measuring heart rate variability at the time of hospital admission in horses with colic. *ajvr*. 81(2):147–52.
20. Bowden A, Burford JH, Brennan ML, England GCW, Freeman SL. (2020). Horse owners' knowledge, and opinions on recognising colic in the horse. *Equine Veterinary Journal*. 52(2):262–7.
21. Allaam M, ELseady Y, Nayel M, Elsify A, Hassan H, Kamar. (2014). Physiological and hemato-chemical evaluation of thoroughbred race horse after exercise. *IJAVMS*. 8 (3):81.
22. Hassan H, Aly M, ELseady Y, Nayel M, Elsify A, Salama A. (2015). The Effect of Race in the Clinical, Hematological and Biochemical Biomarkers in Thoroughbred Horses. *AJVS*. 46(1):161.
23. Hillyer M. A. (2004). Practical approach to diarrhoea in the adult horse. *In Practice*. 26(1):2–11.
24. Youssef MA, Fouda TA, El-Khodery SA, Zaghloul AE, El-Ashker MR (2009). Evaluation of clinical and laboratory

variables as prognostic indicators of gastrointestinal colic in draft horses. *6th Int. Sci. Conf.*

25.Fereig RM. (2023). A review on equine colic: Etiology, differential diagnosis, therapy, and prevention. *Ger J Vet Res.* 3(4):1-12.

26.Koenig J, Cote N. (2006) Equine gastrointestinal motility — ileus and pharmacological modification. *Can Vet J*;47:551-559.

27.Moore JN, Melton T, Carter WC, Wright AL, Smith ML. (2001). A New Look at

Equine Gastrointestinal Anatomy, Function, and Selected Intestinal Displacements. *Aaep Proceedings.* 57: 53-60.

28.Clayton HM, editor. (2005). Clinical anatomy of the horse. 1st ed. Edinburgh; New York: Elsevier Mosby. P:122.

29.Zullian C, Menozzi A, Pozzoli C, Poli E, Bertini S. (2011). Effects of $\alpha 2$ -adrenergic drugs on small intestinal motility in the horse: An in vitro study. *The Veterinary Journal.* 187(3):342-6.

المظاهر السريرية والترددات الصوتية لحالات المغص الحقيقي للخيل في محافظة نينوى

محمود خيرى علي¹، اسامة موفق العراقي².

1- ممارس اقدم. المستشفى البيطري في نينوى. الموصل. العراق

2- فرع الطب الباطني. كلية الطب البيطري. جامعة الموصل. الموصل. العراق.

الخلاصة

شملت الدراسة فحص 50 من الخيل المحلية في مناطق مختلفة من محافظة نينوى للفترة من 2024/4/1-2023/7/1، تضمنت المجموعة الأولى 40 حيواناً أظهرت علامات المغص ومجموعة ثانية مكونة من 10 حيوانات سليمة سريرياً عدت كمجموعة سيطرة وبأعمار أكثر من ستة أشهر ومن كلا الجنسين. تم إجراء الفحص السريري والمتضمن تسجيل تاريخ الحالة المرضية والأعراض الظاهرة على الحيوان فضلاً عن قياس درجة حرارة الجسم وعدد ضربات القلب وتردد التنفس وفحص الأغشية المخاطية للعين ووقت رجوع الدم في الاوعية الشعرية للشفة السفلى وفحص مرونة الجلد. بعدها تم فحص البطن باستخدام السماع الطبية وتسجيل الأصوات في عدة مواقع من جدار البطن ومن كلا جانبي جسم الحيوان. وقد أظهرت الخيل المصابة تغير في تعابير الوجه فضلاً عن ازدياد معدل ضربات القلب 56 ضربة/دقيقة ومعدل تردد التنفس 21 دورة/ثانية ومعدل زمن امتلاء الأوعية الدموية الشعرية 3 ثانية ومعدل اختبار طية الجلد 3.7 ثانية وبشكل معنوي مقارنة مع الخيل السليمة في حين إزداد تردد الصوت عند التسمع من كلا جانبي البطن 272.5 هيرتز من الجهة اليسرى و 249 هيرتز من الجهة اليمنى وكانت النتيجة ذات فرق معنوي من الجهة اليسرى بمقارنتها مع الخيل السليمة، فضلاً عن ازدياد معدل تكرار الصوت 5 لكل دقيقة وبشكل معنوي مقارنة بالخيل السليمة. نستنتج من الدراسة إصابة الخيل بحالات مختلفة من متلازمة المغص ودقة السماع الإلكترونية والتحليل الصوتي في التشخيص السريع.

الكلمات المفتاحية: خيول، مغص، اعراض، تحليل الصوت.