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Ultrasonography as an Accurate Tool for the Diagnosis of Equine Sand Colic with Special Reference to Hematological and Biochemical Alterations

Ali Arbaga[1], Hany Hassan[1*], Mohammed Kasem[1]and Ahmed Kamr[1]

(1) Department of Animal Medicine and Infectious Diseases (Animal Internal Medicine), Faculty of Veterinary Medicine, University of Sadat City, Sadat City 32897, Egypt.
[*]Corresponding author: hany.youssef@vet.usc.edu.eg *Received: 25/3/2024 Accepted: 5/6/2024*

ABSTRACT

A total of thirty native draft horses were divided into two main groups; Group 1: had fifteen healthy, Group 2: had fifteen horses suffered from sand colic. All horses were undergone to a full clinical investigation. DRAMISKI 4 vet diagnostic ultrasound device was used. Horses with sand colic showed mild to moderate colic, anorexia, chronic weight loss, poor performance, sandy manure and characteristic pouring sand sound that heard in ventral abdomen in the area just caudal to the xiphoid region. The rectal palpation in horses with sand colic revealed increased hardness of fecal ball and gassy dilation or impacted segment the colon. The wall of the large colon was seemed "brighter" and more hyperechoic by ultrasonography. The hematobiochemical findings revealed that the values of RBCs, Hb, monocytes, sodium, chloride, potassium and calcium were significantly decreased, while PCV, WBCs, neutrophils and lactate dehydrogenase were significantly increased in horses with sand colic compared to healthy ones.

Keywords: Horses; Sand colic; Ultrasonography; Hematobiochemical alterations.

INTRODUCTION

Equine colic is one of the many diseases that horses are susceptible to (Nagar & Sharma, 2019), it is a multifactorial, complex disorder that causes morbidity, mortality, and premature deaths in all breeds of horses. It can be caused by a variety of conditions, including gastrointestinal diseases known as true colic or false colic, which is caused by abdominal affections unrelated to the gastrointestinal tract such as urinary affections (Sharma et al., 2022).

Sand colic is common in horses fed on the ground or kept in extremely sandy soils; pasture quality has also been linked to a higher risk of fecal sand excretion (Karadima et al., 2021a). Sand accumulation in the gastrointestinal tract, typically in the large intestine, that can result in luminal blockage, motility problems, and irritation of the mucosa which can be manifested clinically by distinct signs, such as diarrhea which can be followed by impaction or intestinal blockage (Granot et al., 2008).

An ultrasound examination may be a quick, noninvasive method to accurately diagnose the cause of equine colic and provide successful treatment. (Pessoa et al., 2023), Despite the widespread use of ultrasonography in the diagnosis of colic, certain gastrointestinal disorders exist, as

sand colic necessitates additional Sonographic examination.

The goal of this study was to early diagnose of sand colic in horses through ultrasonography and evaluate the hematobiochemical alterations associated with equine sand colic.

MATERIAL AND METHODS

Animals

A total of thirty native draft horses of both sexes, ranging in age from 2 to 5 years, were assessed in various seasons throughout the years from 2021 to 2022 in various regions of the Giza governorate (Abu sir, Sakkara, Al Badrashin), Throughout the historical data, clinical, fecal and ultrasonography examinations, the horses were divided into two main groups; Group 1: had fifteen healthy, alert horses with bright eyes showed no clinical signs of the disease and free from external and internal parasites, selected as a control group. Group 2: had fifteen horses suffered from sand colic, which showed signs of restlessness, kicking of the abdomen, rolling, and unusual abdominal sounds associated with the large colon described as similar to water and sand at the beach and sandy manure.

Sampling

Blood was collected from both healthy and diseased horses into tubes with EDTA for hematological examination and also on plain serum clot tubes that centrifuged at 4000 × g for 10 minutes, serum was aliquoted into smaller volumes and stored at -80°C until biochemical analysis.

About five to eight fresh fecal balls was collected from all horses by selection the sample from the top of the manure pile for parasitic infestation as soon as possible through the microscopic examination of fecal sample, and for fecal sand test.

Clinical examination, evaluation of body condition score (BCS) and rectal examination

All horses' case histories were compiled. All horses were underwent to a full clinical investigation including the skin elasticity test to detect the degree of dehydration according to (Radostits et al., 2010). A popular technique was used to evaluate the muscle and fat cover over the different bony prominence on a scoring scale ranged from BCS 0 emaciated horses to BCS 5 obese horses (Rendle et al., 2018). Rectal examination was carried out in accordance with the procedures outlined to evaluate the structures situated in the caudal region of the abdomen, in order to detect any changes in the structure's size, shape, distention, or placement (Londoño, 2017).

Fecal sand test

This method is based on the principle that lighter particles float to the top of a solution while heavier particles sink to the bottom. Collect around five to eight fresh fecal balls straight from the rectum using an obstetric glove, then turn the object inside out. The cuff should be tied after water has been inserted halfway up the glove. The feces are dispersed uniformly with your fingers pointing down, and let the mixture settle (Rood et al., 2011).

Ultrasonographic examination

Ultrasonographic examination was conducted by a low-frequency (2–5 MHz) curvilinear transducer by using DRAMISKI 4 vet diagnostic ultrasound device, in standing position without sedation after Alcohol saturation and coupling gel at site of examination. The left dorsal colon and ventral colon were seen predominantly in the left ventral abdomen. The cecum and the right dorsal and ventral colon were evaluated from the right side of the abdomen (le Jeune & Whitcomb, 2014).

Estimation of the hematobiochemical parameters

This study assessed the hematobiochemical parameters, including red blood cells (RBCS), hemoglobin (Hb), packed cell volume (PCV), white blood cells (WBCs), and differential leukocytic counts, were assessed according to the routine hematological procedures approved by (Meyer & Harvey, 2004). While serum sodium, chloride, calcium, potassium, and Lactate dehydrogenase (LDH), were assessed by the kits of (Bio-diagnostic Company- Egypt), according to the methods specified.

Statistical analyses

The data were normally distributed and reported as means with standard deviations (Mean ± SD). Comparison between two groups was conducted by t-test using IBM SPSS Statistics 16 (IBM Corporation, Armonk, NY, USA). Significance was determined at $P < 0.05$.

RESULTS

Findings of clinical examination, body condition score (BCS) and rectal examination

The clinical examination of fifteen alert healthy horses showed bright eyes, shiny skin, no clinical signs of diseases and free from external and internal parasites. On the other hand, horses with sand colic admitted to the clinic with a history of mild to moderate colic with duration from 48 hours to 8 days, anorexia, chronic weight loss, poor performance and intermittent piles of loose, dark, sandy manure, these horses lived in fields with sandy soil or were fed in sandy paddocks.

The clinical examination showed abnormal motility of the gut that expressed by lowered frequency of borborygmi sound that heard in right side (cecum) and characteristic pouring sand sound that heard in ventral abdomen in the area just caudal to the xiphoid region. The skin elasticity test was less than 2 seconds in healthy horses, while was more than 4 second in horses affected with sand colic as seen in (Figure 1).

Figure 1. showed prolonged skin elasticity test in dehydrated horses suffering from sand colic. The skin did not return to normal after making a fold (arrow).

BCS of healthy horses reveled 3 to 4 BCS, that was characterized by thin layer of fat under the skin, Muscles on neck less defined, Shoulders and neck blend smoothly into body, back is flat or forms only a slight ridge, ribs not visible but easily felt, rump beginning to appear rounded, hip bones just visible, while the diseased group revealed BCS 1 to 2, which was characterized by no fatty tissue can be felt, skin tight over bones, shape of individual bones was visible.

The rectal palpation finding in horses with sand colic showed increased hardness of fecal ball and gassy dilation or impacted segment the colon.

Fecal sand test

Fecal sand test reveled sedimentation of sand particles at the bottom of finger tips of the obstetric glove.

Ultrasound findings of clinical diagnosis of sand colic

In normal horses the left ventral colon by ultrasound had a broad, smooth radius of curvature and was situated in the left inter costal space (ICS) deep to the spleen. The lumen and the colon's far wall could not be seen due to the combination of gas and luminal feed (Figure 2A).

A horse with sand colic typically characterized by flattening of the colon wall against the ventral body wall; presence of small pinpoint hyperechoic structures on the mucosal surface seen casting small acoustic shadows and hyperechoic intraluminal ingesta with loss of normal sacculation and absence of peristaltic activity The wall of the large colon was seemed "brighter" and more hyperechoic (Figure 2B, C, D).

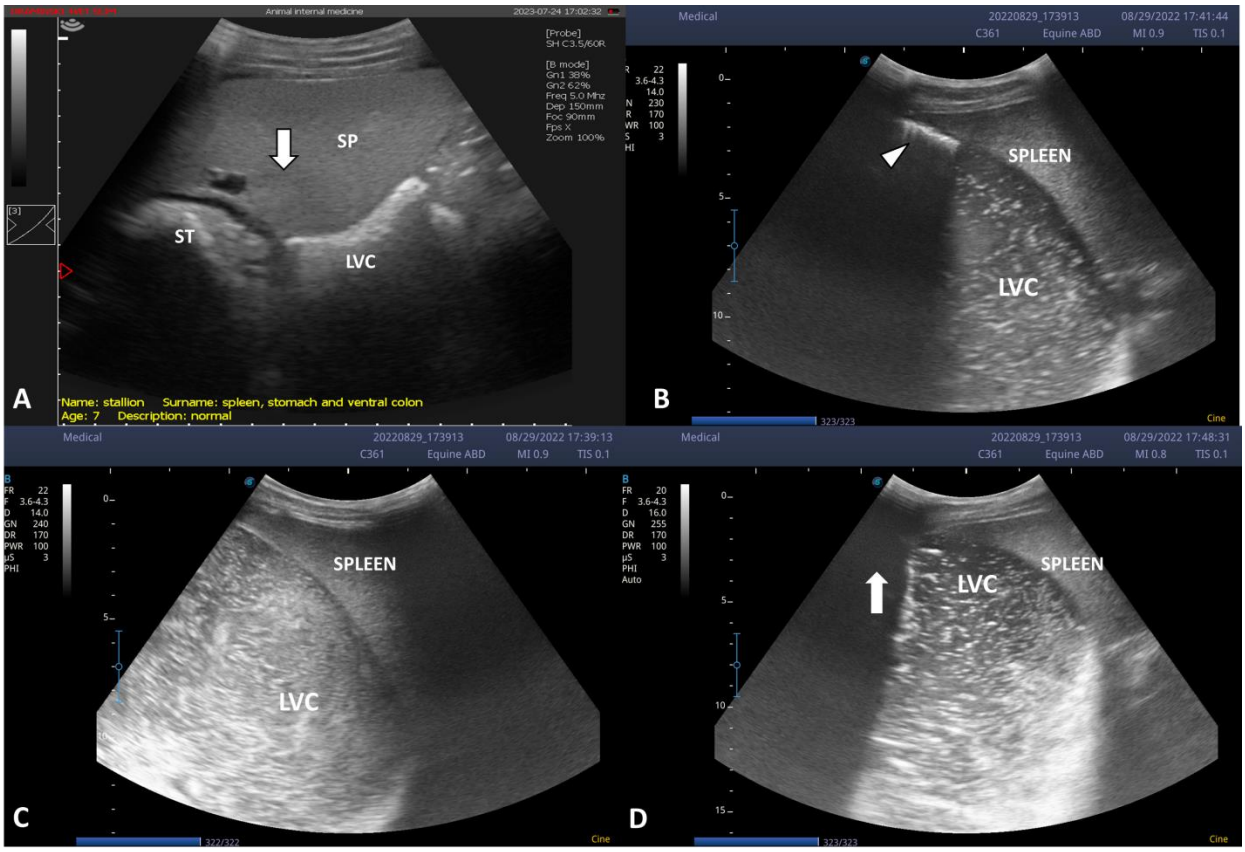

Figure 2. A); healthy horse showed**:** Gastro splenic window. The spleen (SP), gastro splenic vein (arrow), stomach (ST) and left ventral colon (LVC); **B)** Horse with sand colic showed: Ultra sonogram of left middle third of the abdomen showing spleen, left ventral colon (LVC). The wall of the large colon more hyperechoic arrow head; **C)** Small pinpoint hyperechoic structures in lumen of LVC; **D)** Acoustic shadowing due to ribs (arrow), this image obtained from the left 15th ICS using a 3.5-MHz transducer projected to a depth of 15cm. The left side of the image is the dorsal edge.

Hematobiochemical findings of healthy and diseased horses

The hematological findings revealed that the values of RBCs, Hb and monocytes were significantly decreased, while PCV, WBCs and neutrophils were significantly increased in horses with sand colic compared to healthy ones (P value < 0.05), and there was no statistical variation between the healthy and diseased horses of eosinophils count (P value > 0.05) Table 1. The biochemical findings revealed that the concentrations of sodium, chloride, potassium and calcium were significantly decreased, while LDH was significantly increased in horses with sand colic compared to healthy ones (P value < 0.05), Table 2.

Table 1. Hematological profile of healthy and diseased horses.

Variables	Healthy horses (n = 15)	Horses with sand colic (n = 15)
RBCS (10^6/µl)	8.5±0.66	7.2±0.57*
Hb (g/dl)	12.2±0.7	9.65±0.7*
PCV (%)	32±1.9	40.7±2.05*
WBCS (10^3/µl)	11.01±1.4	13.8±1.3*
Neutrophils (10^3/µl)	57.2±1.5	61.1±1.5*
Lymphocytes (10^3/µl)	37.2±1.2	34.4±1.6*
Monocytes (10^3/µl)	4.3±0.9	3.4±0.7 *
Eosinophils (10^3/µl)	1.3±0.48	1.1±0.3

RBCS; red blood cells, WBCS; white blood cells, *P < 0.05.

Table 2. Biochemical and mineral profile of healthy and diseased horses.

Variables	Healthy horses (n = 15)	Horses with sand colic (n = 15)
Sodium (mmol/l)	143.6±1.6	135.5±2.7*
Chloride (mmol/l)	106.3±2.8	98.5±2.3*
Potassium (mmol/l)	4.4±0.22	3.8±0.27*
Calcium (mmol/l)	10.18±1.06	7.8±0.8*
LDH (mmol/l)	1.7±0.22	2.2±0.2*

LDH; Lactate dehydrogenase, *P < 0.05.

DISCUSSION

Regarding to the presumptive diagnosis of diseased horses, horses with sand impaction in the current study showed mild to severe abdominal discomfort, as well as inappetence, slight chronic weight loss, and poor performance as described by (Edens & Cargile, 1997; Ruohoniemi et al., 2001). The clinical symptoms that are thought to indicate sand accumulations are generic and might be caused by a number of different factors (Bertone et al., 1988; Specht & Colahan, 1988). The skin elasticity test was more than 4 seconds in horses with sand colic, which could be attributed to the dehydration state of affected horses (Radostits et al., 2010). The rectal palpation in horses with sand colic showed that increase hardness of fecal balls, gassy dilation or impacted segment in the colon, the same results were described by (Karadima et al., 2021b). Hardness of fecal balls may be due to increase amount of sand in manure, impacted segment with gassy dilation in the colon might be due to gases accumulation as a result of decrease in peristaltic movement.

Regarding to the fecal sand test, the diagnosis in all horses suffered from sand colic was based on the sand identified in the manure, as described in (Rood et al., 2011). Other studies indicate that the fecal sand test is not very significant in the diagnosis of sand colic. Poor sensitivity of fecal sand sedimentation in the detection of colonic sand is one explanation that may be offered (Hassel et al., 2020).

Concerning to the ultrasound examination in the normal healthy horses, the large colon distinguished as a moving structure by looking for a hypoechoic, curved line covering a hyperechoic gas shadow. The adjacent wall and the contents

of the lumen were not visible may be due to the acoustic gas shadow (Hendrickson et al., 2007). The sand impaction of the left ventral colon was strongly suggested by the following observations: flattening of the colon wall against the ventral body wall; presence of small pinpoint hyperechoic structures on the mucosal surface seen casting small acoustic shadows and hyperechoic intraluminal ingesta with loss of normal sacculation and absence of peristaltic activity, our findings were agreed with (Farooq et al., 2021).

The hematobiochemical findings revealed that the values of RBCs, Hb, monocytes, sodium, chloride, potassium and calcium were significantly decreased, while PCV, WBCs, neutrophils and lactate dehydrogenase were significantly increased in horses with sand colic compared to healthy ones, the same results were recorded by (Gagandeep et al., 2017; Gitari et al., 2017) higher concentration of PCV could be attributed to hemoconcentration and dehydration (Pratt et al. 2003), also the significant decrease of RBCs and Hb in horses with sand colic could be related to the anorexic status of the diseased horses (Nikvand et al., 2019). In healthy horses, the cecum and ventral colon have over 2 grams of free endotoxin; the lingering inflammatory alterations may help the body absorb these toxins and mount an immune response which manifested by significant increase in total leucocyte and neutrophil count (Moore et al., 1994). Catecholamines release and an increase in oxygen demand during muscle activity all contributed to an increase in blood lactate levels (DiBartola, 2006). Hyponatremia, hypochloremia, hypokalemia, and hypocalcemia could be caused by excitability brought on by GIT pains, which leads to their loss in sweating (Rani et al., 2018).

CONCLUSIONS

Horses with sand colic typically did not have any motile, swollen loops of the small intestine seen on abdominal ultrasonography. The wall of the large colon was seemed "brighter" and more hyperechoic and associated with lower concentrations of RBCs, Hb, sodium, chloride, potassium and calcium and higher concentrations of WBCs, neutrophils and lactate dehydrogenase.

CONFLICT OF INTEREST

No conflict of interest was declared by authors

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