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Clinical, Haematological and Biochemical Studies of Colic in Draught Horses and Donkeys in Nyala

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ABSTRACT

This study was conducted to identify the underlining aetiological agents of equine (horses and donkeys) colic and to investigate the clinical, haematological and biochemical changes that may occur during colic period. A total number of 80 draught horses and 11 draught donkeys (colic group) were clinically examined in Nyala, South Darfur State, Sudan. Animals with colic were assigned into mild, severe and recurrent subgroups according to the severity of pain and degree of change in clinical parameters. For the purpose of normal standard values six donkeys and six horses (control group) were included in the study. Causes of colic were identified from the case history of the colic in equine and/or by the test of its food before colic, clinical parameters, blood capillary refill time, and rectal palpation were conducted using standard methods. PCV, Hb, white blood cells differential count were recorded also. Plasma glucose, total protein, albumin, urea, sodium, potassium, and calcium were measured using spectrophotometery methods.

PCV and Hb were significantly increased in animals with severe colic, but no differences were found between mild subgroup and control group; total white blood cells number significantly increased in colic group, but no differences were noticed in the white blood cells differential count of colic group except the basophiles, which decreased in colic group. No changes were noticed in sodium, urea, total protein and albumin between control group and colic group; globulin and glucose increased significantly in colic group, but calcium and potassium were found in low levels in the same group.

INTRODUCTION

Equine colic is considered the major disease states in horses and donkeys causing severe abdominal pain. Colic is a frequent and important cause of death to these species of

animals. The aetiological agents to this clinical syndrome are several including disease base system that classifying the cause of colic as obstructive and strangulating, non strangulating infarctive and inflammatory such as peritonitis, and enteritis (Radostits *et al.*, 2007). Also another classification system based on anatomy of the structure of gastrointestinal tract was suggested by Cohen *et al.*, (1999). In this state, colic can be due to gastric dilatation or volvulus in small intestine or impaction of caecum.

Hewetson (2006) defined the clinical sign syndrome as spasm of digestive system and the major sign is the pain which manifested by pawing, stamping, kicking or rolling (Radostits *et al.*, 2007). The pain of the abdomen can be classified according to Archer and Proudman (2006) to true colic in the digestive system from false colic outside the as in the liver, urinary system and others. Colic causes related to food, management, and specific diseases such as pleurisy, and azoturea were reported by Alsaad and Nori, (2009). Equine colic also caused changes in some blood indices such as increasing of PCV, and total White blood cells (Alsaad and Nori, 2009), and change of some biochemical parameters like increasing of total protein, albumin (Alsaad and Nori, 2010), glucose (Hassel *et al.*, 2009) and decrease of potassium (Nappert and Johnson, 2001). Losses caused by equine colic are almost entirely due to death of these animals. However the cost of treatment and the emotional trauma to the owners of their animals being afflicted with potentially fatal disease are important consideration, but no previous study of equine colic was done in Sudan.

The objectives of this study were to identify the underlining causes, and to report on clinical signs, haematological and blood biochemical alterations that might accompany colic.

MATERIALS AND METHODS

Study area:

The current study was conducted in Nyala, South Darfur state, western Sudan that is located between Latitude 13-9.30º North and Longitude 27-24.30º East.

Study population and inclusion criteria:

A total number of 80 draught horses and 11 draught donkeys were examined in Nyala, South Darfur State, Sudan. Animals showed signs of colic were included in the study.

Classification of colic cases:

According to severity of pain: Surveyed animals were assigned according to the severity of pain into three groups viz: mild, recurrent, and severe.

Mild: Animals showed clinical signs as flank watching, getting up and down, stretching, rolling on the ground, positive rectal palpation, and heart rate 50 -60 beat/minute, were considered as mild colic cases.

Severe: Whereas animals with sweating, restlessness, severe uncontrollable rolling, muscle tremor, abdominal distension, capillary refill time more than 4 seconds, negative rectal palpation, heart rate more than 60 beat/minute, were considered as severe colic cases.

Recurrent colic: animals with episodes of colic at 20-30 minutes interval were considered as having recurrent colic.

Clinical examination:

History: A detailed history of the cases was obtained from the owner and examination of source of feed, environment, and source of water as described by Kelly (1984).

Clinical signs: Clinical signs were documented for each individual case according to Kelly (1984).

Physiological parameters: All animals were examined clinically for estimation of respiratory rate, pulse rates, rectal temperature, eye mucous membrane colour, capillary refill time, percussion auscultation,

and rectal palpation, using standard methods according to Kelly (1984).

Blood samples collection:
Following aseptic technique procedures, five millilitre of whole blood were collected from the Jugular vein of each animal by disposable syringe; 2.5ml were mixed with EDTA in plastic container for haematological indices. The remaining part (2.5ml) of the blood was mixed with fluoride in plastic container for plasma separation, for measurement of blood biochemical parameters.

Haematological indices:
The whole blood was tested for the determination of red blood cell count (RBCs) 10^6 cell/µl, haemoglobin concentration (Hb) g/dl, packed cell volume (PCV) %, Total white blood cells (WBCs) 10^3 cell/µl, and differential count of the white blood cells according to Jain (1986).

Blood biochemical parameters
The following blood biochemical parameters: glucose, total proteins (King and Wooton, 1956), albumin (Bartholomew and Delany (1966), glucose, urea (Fawcett and Scott, 1960) and calcium (Sarkar, and Chauhan, 1967) were measured following spinreact, (S.A-Ctra. Santa colmba; Girona Spain) instructions. While, sodium and potassium (Wootton, 1974) were measured using BioMed kits (Germany).

Faecal sampling and analysis:
Fresh faecal sample was taken directly from the rectum of each colic case suspected with verminous colic for egg count and culture. Modified McMaster technique was used for egg count according to (Anonymous, 1986). Positive faecal sample for egg of internal parasites was cultured and infected larvae were harvested by Baermann technique, as described by Zajac and Conboy (2006) for more accurate diagnosis. Percentage of the infestation was also determined.

Control animals:
For the purpose of normal standard values, six donkeys and six horses were included in this study; they were examined for normal clinical, physiological and haematological parameters included in this study.

Statistical analysis:
One way analysis of variance (ANOVA) was used for analysis of data obtained from horses, whereas Descriptive statistics was used for description of data that obtained from donkeys.

RESULTS

Aetiology of colic in horses and donkeys:
The main encountered causes of colic in horses were unknown causes (25%), feeding large amount of rough dry fodder (23.75%) and feeding large amounts of grains (16.25%). While in donkeys feeding large amount of green fodder (27.3%) and urinary infection (18.2%), were the main causes encountered. Other causes were enlisted in Tables (1 and 2).

Table 1: The most encountered causes of colic in horses

Cause	Frequency	%
Feeding large amount of grains	13	16.25
Feeding large amount of green fodder	9	11.25
Feeding large amount of rough dry fodder	19	23.75
Sand	1	1.25
Helminths infestation	5	6.25
Urinary origin (urine retention)	11	13.75
Unknown causes	20	25
Protein overload	2	2.5
Total	80	100

Table 2: The most encountered causes of colic in donkeys

Cause	Frequency	%
Feeding large amount of grains	1	9.1
Feeding large amount of green fodder	3	27.3
Plastic	1	9.1
Feeding large amount of rough dry fodder	1	9.1
Helminths infestation	1	9.1
Monday morning disease	1	9.1
Urinary infection	2	18.2
Unknown causes	1	9.1
Total	11	100

Clinical signs

According to the severity of the clinical signs colic group was divided into subgroups recurrent, mild and severe. Noticed clinical signs (Tables 3 and 4) included flank watching (Figure1), stretching (Figure 2), pawing at the ground, restlessness curling of lips were observed in mild colicky cases. Rolling (Figure 3), running, muscle tremor, still lying down, and sweating were observed in severe colic cases. Three types of eye mucous membrane colour (congestion, petechial haemorrhage, and cyanosis) (Figure 4) were also noticed in this study. Dilatation of anal sphincter was observed in horses and coffee like urine in azoturea cases.

Table 3: Frequency of clinical signs noticed in colicky horses (No=80)

Clinical signs		No. of cases	%
Pain		80	100
Diarrhoea		4	5
Constipation (Dry offensive faeces)		8	10
Urine colour (oil –like urine)		10	12.5
Mucous membrane colour	Congested	50	62.5
	Petechial haemorrhage	29	36.25
	Cyanosis	1	1.25
Normal heart sounds		79	98.75
Abnormal heart sounds		1	1.25
Tight rectal sphincter		75	93.75
Dilated rectal sphincter		4	5
Rectal prolapsed		1	1.25
Rectal palpation *	Faeces detected	51	63.75
	Faeces not detected	28	35

* In one case the animal was very tough so we could not either check it rectally or listen to its' GIT sounds.

Table 4: Frequency of clinical signs noticed colic in colicky donkeys (No=11)

Clinical signs		No. of animals	%
Pain		11	100
Urine colour (coffee –like urine)		1	9.1
Mucous membrane colour	Congested	5	45.5
	Pink colour	6	54.5
Normal heart sounds		11	100
Abnormal heart sounds		0	0
Tight rectal sphincter		11	100
Dilated rectal sphincter		0	0

*All cases were small in size so rectal palpation was not done.

Figure 1: watching flank region

Figure 2: Stretching

Figure 3: Rolling in the ground

Figure 4: Cyanosis of mucous membrane

Classification of colic according to severity of pain

From Table (5) it is clear that the most cases of colic in horses were mild and only one case of recurrent colic was found; in donkeys 8 cases were mild and 3 severe.

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Table 5: Classification of colic in horses according to severity of pain

Severity of clinical signs	No. of cases	%
Mild	48	60
Severe	31	38.75
Recurrent	1	1.25
Total	80	100

Changes in physiological parameters in colicky horses

From Table (6) Respiratory rate was increased in all mild and severe colic cases, while there was no differences in pulse rate, temperature and capillary refill time were found between mild colic cases and normal control group; all of the three increased in severe colic cases.

Table 6: Physiological parameters of colicky horse compared to control group

Parameter	Control	Mild	Severe
Respiration rate	26 ± 8.29^{c}	37.2 ± 14.49^{b}	46.62 ± 20.72^{a}
Pulse rate (beat/min.)	43.3 ± 4.67^{b}	51.63 ± 13.20^{b}	92.76 ± 31.72^{a}
Temperature (°C)	37.2 ± 0.25^{b}	37.86 ± 1.14^{b}	38.22 ± 0.94^{a}
Capillary refill time	2 ± 0.00^{b}	2.27 ± 0.73^{b}	4 ± 1.87^{a}

*Values are mean ± standard deviation

*Values with different letters in the same row are significantly different (p· 0.05)

In Table (7) the range of respiratory rate in colic group is wider than in control group, because some cases had deep respiration and low rate, in the pulse rate and capillary refill time the range is also wider in colic group, because three severe colic cases with higher readings were included in the mentioned group.

Table 7: Physiological parameters of colicky donkeys (n=11) and control group of donkeys (n=6)

Parameter	Colicky donkeys			Control group		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Respiratory rate	36	20	52	32	24	48
Pulse rate	55.7	32	112	47.3	40	60
Temperature	36.2	35.1	37.7	37.7	37.1	38.2
Capillary refill time	2.4	1	5	1.3	1	2

Haematological changes in colicky equine

From the Table (8), no differences in PCV and Hb were found between control and mild colic cases but both of them increased in the severe colic cases; total white blood cell count increased in both mild and severe colic cases, but no differences were notice in the differential count of colic group except the basophiles which decreased in both of mild and severe colic cases.

Table 8: Haematological indices of control group and colicky horses

Parameter	Control	Mild	Severe
PCV (%)	34.5±3.39[b]	35.92±8.73[b]	44.69±8.99[a]
Hb	13.67±1.37[b]	12.29±2.61[b]	15.07±3.33[a]
RBCS	851.17±139.59[b]	1229.54±447.32[a]	1303.5±545.94[a]
WBCS	4650±742.29[b]	12675.64±8514.10[a]	13673±5236.77[a]
Neutrophils	59.50±10.04[a]	59.78±19.26[a]	71±13.86[a]
Basophils	1.67±1.63[a]	0.27±0.67[b]	0.16±0.45[b]
Acidophil	1.67±1.03[a]	1.93±1.51[a]	2.84±2.93[a]
Lymphocytes	35.17±10.53[a]	34.07±17.24[a]	23.97±13.33[a]
Monocytes	2±1.27[a]	1.8±2.85[a]	1.32±1.51[a]

*Values are mean ± standard deviation
*Values with different letters in the same row are significantly different (p▪ 0.05)

In Table (9) the range of white blood cell count is wider than in normal control group because total number in higher in severe colic cases than in mild colic cases.

Table 9: Haematological parameters of colicky donkeys (n=11) and the control group (n=6)

Haematological parameter s	Colicky donkeys			Control group		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum
PCV (%)	35.9	30	42	32	30	35
Hb	11.5	8	15	11	9	13
RBCs	$971X10^4$	$500X10^4$	$1750X10^4$	$615.7X10^4$	$300X10^4$	$942X10^4$
WBCs	12452	9700	15800	8633	7200	11000

Biochemical changes in colicky equines

From Tables (10 and 11) no differences were found in total protein, albumin, urea and sodium between control group and mild and severe colic cases, but increase of globulin and glucose and decrease of calcium and potassium were recorded in mild and severe colic cases.

Table 10: Biochemical parameters of control group and colicky horses

Parameter	Control	Mild	Severe
Total proteins	7.10±0.81[a]	7.29±2.38[a]	7.53±1.68[a]
Albumin	3.52±0.44[a]	2.89±1.04[a]	3.46±1.39[a]
Globulin	2.1±0.00[c]	4.45±1.87[a]	4.34±1.72[b]
Glucose	85.80±14.79[c]	149.89±80.59[b]	187.21±98.23[a]
Urea	48.73±5.25[a]	61.59±42.13[a]	71.67±47.90[a]
Calcium	7.83±1.72[c]	3.69±2.09[b]	2.89±1.53[c]
Potassium	17.50±8.95[a]	1.45±1.99[c]	1.99±3.81[b]
Sodium	326.97±22.99[a]	281.72±465.73[a]	196.66±90.03[a]

*Values are mean ± standard deviation
*Values with different letters in the same row are significantly different (p▪ 0.05)

Table 11: Biochemical parameters of colicky donkeys (n=11) and control group (no=6)

Parameter	Colicky donkeys			Control group		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Total proteins	7.8	6.5	8.8	6.2	4.3	8
Albumin	3.3	3	3.6	3.4	1.6	4.2
Globulin	4.4	3.3	5.8	2.7	0.7	5.8
Glucose	67.4	56.5	82.6	250.3	46.2	350.7
Urea	26	17	38	95.1	58.3	154.2
Calcium	4.2	3	6	4.3	0.3	10.8
Potassium	24.3	18.3	29.2	8.7	0.00	25.3
Sodium	274.3	290.6	326	274.3	170.7	350.8

DISCUSSION

Identified causes of colic in this study included, eating large amount of grains, green fodders, and rough dry fodder, in addition to protein over load and urine retention, these causes were in agreement with those reported in a previous study by Alsaad and Nori, (2010); *Strongylus vulgaris* as a cause of colic was also previously reported by Reinemeyer and Nielsen (2009). Failure of ivermectin and albendazole to remove *Strongylus vulgaris* larvae was reported by Seri *et al.*, (2005) and sawsan *et al.*, (2010).

Animals with colic were divided into three subgroups mild, severe and recurrent according to the severity of pain. Different clinical signs were observed in colicky cases included: flank watching, stretching, pawing at the ground, curling of lips, rolling, running, muscle tremor, still lying down, sweating, and abnormal eye mucus membrane colour. These sings are in agreement with that reported by Ayaz *et al., (*1999), Alsaad and Nori, (2009), and Scantlebury *et al*., (2011). The more serious signs were in severe colic cases, and this may be attributed to the physiological changes and severity of pain (Blood *et al.,* 1989), theses signs included: rolling, running, muscle tremor, still lying down, and sweating. Flank watching, stretching, pawing at the ground, restlessness curling of lips was observed in mild colicky cases.

Documented elevation of capillary refill time and pulse rate in severe colic cases in this study is in agreement with observations in previous studies (Reeves *et al.,* 1989, Hillyer *et al.*, 2008, Sutton *et al.,* 2009; Alsaad and Nori, 2010). The increase in respiratory rate in both mild and severe colic cases is similar with that observed by Ayaz *et al.,* (1999) and Alsaad and Nori (2010) who attributed the increase of respiratory rate to pain (Bryan *et al.,* 2009). No differences in capillary refill time, and pulse rate between mild colicky animals and the control group were detected, this could be justified as that pain relatively has minor effect on the heart rate as long there were no haemoconcentration, reducing venous return which affect capillary refill time, and endotoxaemia, all of that made pulse rate important indicator of severity of the colic and its effect on the cardiovascular system (White and Edwards, 1999). Blood *et al.,* (1989) added remarkable physiological changes that happen due to pain are determined by severity of the pain, so that these physiological parameters increase according to degree of pain. Rectal temperature was elevated in severe colic cases this result is in the same line with that reported by Ayaz *et al.,* (1999) and Alsaad and Nori (2009), while no change was observed in mild colic cases. Body temperature was usual in the normal range in colicky horses, sometimes it decreases as in shocked cases as reported by Blood *et al.,*

(1989) and Hillyer *et al.,* (2008), or increase Blood *et al.,* (1989) Alsaad and Nori, (2010) and Hart *et al.,* (2012) as in severe pain Alsaad and Nori (2010) due to either physical effort (Blood *et al*., 1989) or presence of pyrogenic agent (Blood *et al*., 1989 and Bryan *et al.,* 2009).

Packed cell volume (PCV) was significantly increased in severe colic cases a result which is in agreement with Ayaz *et al.,* (1999) and Alsaad and Nori, (2010), while no effect on PCV and Hb level was observed in mild colic cases. An increase of haemoglobin was observed in severe colic cases a result that is not consistent with that observed by Alsaad and Nori, (2010).This may be as in human, in whom visceral pain may not lead to recognizable either organic or biochemical changes as happen in functional gastrointestinal disorders (Farmer and Aziz, 2013). Alsaad and Nori, (2010) showed that, as in this study total white blood cells were significantly increased in colic cases. While, no significant variation was seen in differential white blood cells percentages in this study except a decrease in basophiles in both mild and severe colic cases, increasing of white blood cells was justified by saying that colic is considered as stress factor (Blood *et al*., 1989) it increases corticosteroid levels in the blood, that forbid migration of white blood cells out of the blood vessels to the tissues, in addition to that neutrophils migrate from the marginal pool to the blood stream during pain, both of them increase the total count of the white blood cells in the blood, this increase in total white blood cells may not be accompanied with effects on differential count percentages (Kerr, 2002) Tables.

No differences in total protein, albumin and urea between normal control horses and colic group were observed, but globulin significantly increased in colic group in this study. Plasma protein is affected by blood water which can decrease in case of over hydration and increase in case of dehydration in which all fractions of protein (albumin and globulin) increase by the same percentage, but when there is increase of total protein because of inflammation only globulin increase and albumin either remain unchanged or decreased (Kerr, 2002).

Plasma glucose was increased in mild and severe colic cases compared to the normal control group; this result is in agreement with reported by Hassel *et al*., (2009) and is not in line with the observations of Alsaad and Nori, (2010). Increasing of plasma glucose during colic was justified by increasing of both glucocorticoids and adrenaline during pain (Kerr, 2002).

Decreasing of potassium level in both mild and severe colic horses in this study matches the previous result of Nappert and Johnson (2001) and differs from the result of Ayaz *et al.,* (1999) who reported that potassium level was not influenced by colic and from Alsaad and Nori (2010) who indicated that potassium increases in acute and recurrent colic cases. Kerr, (2002) explained that, plasma potassium level in horse is fluctuating even in healthy horses, it can decrease in them either due to its losing in their saliva during eating hay or in sweat during prolonged exercise because they have high concentration of potassium in their sweat, oppositely plasma potassium level in horses increase during active exercises.

Decreasing of plasma calcium level which was reported in this study is in agreement with the result reported by Alsaad and Nori, (2010) who agreed with Corley (2002), that both of intestinal disturbance and clots that happen during acute colic reduce calcium level in their blood.

Sodium is related to the body water balance, so its disturbance depends on the body water problems. No change in sodium plasma level happened in mild and severe colic cases in this study because when the loss of electrolytes is isotonic to the extracellular

fluids the plasma electrolytes do not affected. Different results were reported by Ayaz *et al.,* (1999) and Alsaad and Nori, (2010) indicated that sodium plasma level decrease in colic cases.

CONCLUSION AND RECOMMENDATIONS

Calcium and potassium should be corrected during treatment of equine colic, but glucose should not be given to horses and donkeys with colic as it was found high. Equines should be given special attention so as to avoid risk factors and causes of colic which may be fatal; more studies are needed for evaluation of severe colic cases specially measurement of hormones (glucocorticoids), and for specific treatment of those cases.

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