A STUDY ON HAEMATO-BIOCHEMICAL AND ELECTROLYTE ALTERATIONS IN NEONATAL CALF DIARRHOEA

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ABSTRACT

A study was conducted to determine the haemato-biochemical and electrolyte changes in 32 neonatal cattle calves affected with diarrhoea. Findings revealed significant increase in the mean values of Hb, PCV, TEC, MCV, TLC, neutrophils, total protein, albumin, globulin, glucose, BUN, creatinine and potassium, whereas significant decrease in mean values of MCHC, lymphocytes, sodium, chloride and bicarbonate of diarrhoeic calves as compared to healthy group of calves. No significant alterations were observed in the mean values of MCH, eosinophils, basophils, A:G ratio, ALP, ALT and AST of diarrhoeic calves.

Key words: Neaonatal cattle calves, diarrhoea, haemato-biochemical, electrolyte

Introduction

Diarrhoea is an increase in faecal water content with an associated increase in frequency, fluidity and volume of bowel movements, and is one of the most frequently reported disorder in veterinary practice. Neonatal calves are at greatest risk of diarrhoea within the first month of life (Garcia *et al.,* 2000). Neonatal calf diarrhoea is a multifactorial syndrome and may be having infectious or non-infectious etiology (Izzo *et al.,* 2011). Infectious diarrhoea is the most significant cause of morbidity and mortality in neonatal dairy calves throughout the world and it can be caused by many pathogens including bacteria, viruses and protozoa (Izzo *et al.,* 2011). Diarrhoea can be fatal to neonatal calves due to dehydration and acidosis that may result in anorexia and ataxia (Berchtold, 2009). The national animal health monitoring system (NAHMS) for dairy in United States reported that 57% of unweaned calf mortality is due to diarrhoea especially in calves less than one month of age (USDA Dairy, 2008). Diarrhoea in neonatal calves may leads to potentially serious metabolic derangements which results in impairment of cellular and organ functions and consequently associated with an increased risk of mortality (Trefz *et al.,* 2017). Brar *et al.* (2015) revealed that the levels of different haematological and biochemical parameters can be used to assess the severity of diarrhoea and metabolic disturbances in affected animals. Therefore, a study was conducted in neonatal cattle calves to determine changes in haemato-biochemical and electrolyte parameters associated with diarrhoea.

Materials and Methods

A total of 32 neonatal cattle calves below 1 month of age irrespective of sex and breed showing classical clinical signs of diarrhoea at private dairy farms as well as animals of individual holdings in Bikaner district of the Rajasthan state were the source of animals for the present study. Eight apparently healthy neonatal cattle calves were also included in the study for statistical analysis of data. Blood samples of all the claves were collected from jugular vein in EDTA containing and non-anticoagulant vacutainers, and were immediately transported to laboratory in ice box. The EDTA containing blood samples were used for estimation of various haematological parameters *viz.* haemoglobin (Hb), packed cell volume (PCV), total erythrocyte count (TEC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), total leukocyte count (TLC) and differential leukocyte count (DLC) on the same day as per the methods described by Feldman *et al*. (2000). Blood samples without anticoagulant were used for separation of serum for biochemical and electrolyte analysis. Various serum biochemical parameters *viz.* total protein, albumin, globulin, A:G ratio, glucose, creatinine, blood urea nitrogen (BUN), alanine aminotransferase (ALT), aspartate aminotransferase (AST) and alkaline phosphatise (ALP) were determined by using the IDEXX VetTest Chemistry Analyzer. Serum samples were analysed for estimation of various electrolyte parameters *viz.* sodium, potassium, chloride and bicarbonate by using by CKK Lyte Electrolyte Analyzer (ARK Diagnostics Pvt. Limited, Bangalore). The data obtained in the research work undertaken were statistically analyzed and compared by using T test as per the standard statistical procedures described by Snedecor and Cochran (1994).

Results and Discussion

In the present study, blood and serum samples were collected from 32 diarrhoeic neonatal cattle calves for haemato-biochemical and electrolyte analysis and obtained data were statistically compared with corresponding values of 8 apparently healthy calves.

The mean ± SE values of various haematological parameters of healthy and diarrhoeic calves estimated in present study are presented in Table 1. In the present study, mean values of Hb, PCV and TEC were significantly higher ($p<0.01$) in diarrhoeic calves as compared to healthy calves. These were in agreement with the findings of Garkhal *et al.* (2017), Shekhar *et al.* (2017), Aref *et al*. (2018) and Nayak *et al.* (2019). In contrary, Sahu and Maiti (2011) recorded significant decrease in mean values of Hb and TEC and significant

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increase in PCV in bovine calves affected with diarrhoea. In the present study, significantly higher values of Hb, PCV and TEC in diarrhoeic calves might be associated with excess loss of intestinal fluid resulting in severe dehydration, haemo-concentration and hypovolaemia (Eddy and Pinsent, 2004; Reddy *et al*., 2016).

Table 1: Mean ± SE values of haematological parameters in healthy and diarrhoeic calves

S. No.	Parameters	Healthy calves (n=8)	Diarrhoeic calves (n=32)	Statistical analysis (T test)
1	Hb (g/dl)	10.63±0.21	12.78±0.15	**
2	PCV (%)	35.69±0.80	45.99±0.47	**
3	TEC (×10^6/µl)	7.71±0.16	8.98±0.17	**
4	MCV (fl)	46.40±1.30	51.52±0.63	**
5	MCH (pg)	13.80±0.30	14.29±0.13	NS
6	MCHC (g/dl)	29.81±0.47	27.79±0.22	**
7	TLC (× 10^3/µl)	10.37±0.13	13.87±0.17	**
8	DLC			
i	Neutrophils (%)	38.88±0.64	45.84±0.38	**
ii	Lymphocytes (%)	59.00±0.73	52.44±0.41	**
iii	Eosinophils (%)	1.50±0.33	1.19±0.16	NS
iv	Basophils (%)	0.63±0.18	0.53±0.09	NS

**=p<0.01 *=p<0.05 NS=Non significant (p>0.05)

There was significant increase (p<0.01) in mean value of MCV, non-significant increase (p>0.05) in value of MCH, whereas significant decrease (p<0.05) in value of MCHC in diarrhoeic calves in comparison with healthy group of calves. Almost similar findings were reported by Mir (2009) and Nayak *et al.* (2019) who also recorded higher MCV and MCH, and lower MCHC values in calves affected with diarrhoea. Alterations in the values of MCV, MCH and MCHC in the present investigation were due to variations in the levels of Hb, PCV and TEC in diarrhoeic calves.

The mean value of TLC in calves affected with diarrhoea was significant higher (p<0.01) than healthy calves, which was in agreement with many previous studies conducted by Garkhal *et al.* (2017), Aref *et al.* (2018), Jaiswal *et al.* (2019) and Nayak *et al.* (2019) who also reported significant leucocytosis in diarrhoeic calves. In contrary, Asati *et al*. (2008) reported decrease in mean value of TLC, and Santos *et al.* (2002) revealed transitory leucopenia in diarrhoeic calves. Leucocytosis in calf diarrhoea might be attributed to microbial infection and associated neutrophilia (Eddy and Pincent, 2004).

The differential leucocyte count (DLC) estimation in the present study revealed significant (p<0.01) neutrophilia and lymphopenia in calves affected with diarrhoea as compared to healthy group of calves, which were in agreement with previous studies conducted by Bashir *et al.* (2015), Brar *et al*. (2015) and Nayak *et al.* (2019). In contrary, Asati *et al*. (2008) recorded neutropenia and lymphocytosis in diarrhoeic calves. In the initial stage of diarrhoea in calves significant increase in number of circulatory neutrophils associated with leucocytosis indicated pathogenic bacterial infection (Malik *et al*., 2013). Reddy *et al.* (2016) revealed that marked neutrophilic response with lymphopenia in diarrhoeic calves was characteristic of acute bacterial enteritis.

The mean ± SE values of various serum biochemical parameters estimated in the present study are depicted in Table 2.

There was significant increase (p<0.01) in mean value of total protein in affected calves as compared to healthy calves. Almost similar findings in the calves affected with diarrhoea were also reported in past by Aref *et al.* (2018), Jaiswal *et al.* (2019) and Nayak *et al.* (2019). In contrary, and Sahu and Maiti (2011) recorded hypoproteinaemia, whereas Albayrak and Kabu (2016) revealed non-significant changes in total protein levels in diarrhoeic calves. Hyperproteinaemia in the present study might be attributed to haemo-concentration, hypovolaemia and decreased glomerular filtration rate (Walker *et al*., 1998) due to dehydration in diarrhoeic calves.

Findings of present study revealed significantly higher (p<0.01) values of albumin and globulin in diarrhoeic calves than in healthy calves, whereas non-significant difference in values of A:G ratio. Significant hyperalbuminemia and hyperglobulinemia in calf diarrhoea as recorded in present study were also reported in past by Fernandes (2006) and Garkhal *et al.* (2017) which might be due to definitive bio-response to abnormal loss of body fluids in diarrhoeic calves (Walker *et al*., 1998).

The mean value of glucose in diarrhoeic calves was significantly lower than healthy calves which were in agreement with previous reports of Shekhar *et al.* (2017) and Nayak *et al.* (2019). Hypoglycaemia in diarrhoeic calves might be attributed to inappetence/anorexia, decreased intestinal absorption of glucose and reduced rate of conversion of lactic acid into glucose (Morris *et al*., 1985).

In the present investigation, mean values of BUN and serum creatinine were significantly higher (p<0.01) in comparison with healthy calves. These findings of present study were in accordance with previous reports of Abdullah *et al.* (2016), Garkhal *et al.* (2017), Aref *et al.* (2018) and Nayak *et al.* (2019). BUN and creatinine concentrations might be increased due to inadequate renal perfusion associated with haemo-concentration and hypovolaemia due to dehydration in diarrhoeic calves (Constable *et al*., 2017).

In the present investigation, no statistically significant alterations (p>0.05) were observed in mean values of ALP, ALT and AST which indicated absence of any marked hepatic damage in calves affected with diarrhoea. These results were in consistent with the findings of Nayak *et al.* (2019). Albayrak and Kabu (2016) and Shekhar *et al.* (2017) also reported non-significant changes in values of ALT and AST in diarrhoeic calves.

Table 2: Mean ± SE values of serum biochemical parameters in healthy and diarrhoeic calves

S. No.	Parameters	Healthy calves (n=8)	Diarrhoeic calves (n=32)	Statistical analysis (T test)
1	Total Protein (g/dl)	6.56±0.09	7.98±0.10	**
2	Albumin (g/dl)	2.96±0.04	3.72±0.05	**
3	Globulin (g/dl)	3.60±0.09	4.26±0.07	**
4	A:G ratio	0.827±0.026	0.878±0.014	NS
5	Glucose (mg/dl)	59.63±1.46	45.91±0.43	**
6	BUN (mg/dl)	17.95±0.95	27.35±0.29	**
7	Creatinine (mg/dl)	0.686±0.015	1.695±0.017	**
8	ALP (U/L)	77.74±0.87	78.44±1.12	NS
9	ALT(U/L)	37.20±1.28	38.36±0.45	NS
10	AST(U/L)	16.25±0.45	16.80±0.33	NS
**=p<.01 *p<.05 NS=Non significant (p>.05)				

The mean ± SE values of various serum electrolyte parameters determined in the present study are presented in Table 3.

Mean value of sodium in diarrhoeic calves was significantly lower (p<0.01) than healthy calves which was in agreement with many studies conducted in past by Shekhar *et al.* (2017), Amrutha *et al.* (2018), Aref *et al.* (2018), Jaiswal *et al.* (2019) and Nayak *et al.* (2019). Opposite to our findings, Kaur *et al.* (2006) reported hypernatraemia in diarrhoeic calves. In the present study, hyponatraemia in diarrhoeic calves might be attributed to excessive secretion of sodium ions by intestinal villus cells and loss through intestinal tract of affected animals (Radostits *et al*., 2009).

Table 3: Mean ± SE values of serum electrolyte parameters in healthy and diarrhoeic calves

S. No.	Parameters	Healthy calves (n=8)	Diarrhoeic calves (n=32)	Statistical analysis (T test)
1	Sodium (mmol/L)	132.56±0.87	125.97±0.31	**
2	Potassium (mmol/L)	5.15±0.08	5.67±0.05	**
3	Chloride (mmol/L)	99.06±0.75	95.19±0.27	**
4	Bicarbonate (mEq/L)	23.83±0.32	15.26±0.22	**

**p<0.01 *p<0.05 NS=Non significant (p>0.05)

In the present investigation, mean value of potassium in diarrhoeic calves was found significantly higher (p<0.01) than healthy calves. Similar findings were also reported by Abdullah *et al.* (2016), Shekhar *et al.* (2017), Aref *et al.* (2018), Jaiswal *et al.* (2019) and Nayak *et al*. (2019) in calves affected with diarrhoea. On the other side, Sahu and Maiti (2011) observed hypokalemia in diarrhoeic calves. Increased retention of potassium ions by kidney, increased renal tubular reabsorption of potassium ions in response to acidosis and cellular damage might be the most probable reasons of hyperkalemia found in diarrhoeic calves during the present study (Radostits *et al*., 2009). In addition, movement of potassium ions from intracellular to extracellular fluid might also played a contributory factor for hyperkalemia (Tasker, 1991).

The mean value of chloride in diarrhoeic calves was found significantly lower (p<0.01) than healthy calves. Hypochloraemia in diarrhoeic calves observed in the present investigation was in agreement with many previous studies conducted by Bednarski *et al.* (2015), Jaiswal *et al.* (2019) and Nayak *et al.* (2019). In contrary, Malik *et al.* (2013), Bashir *et al.* (2015) and Shekhar *et al.* (2017) reported hyperchloraemia in calves affected with diarrhoea. In the present investigation, hypochloraemia found in diarrhoeic calves might be attributed to increased loss of chloride ions in the intestinal tract and failure of re-absorption of gastric hydrogen and chloride ions by functional cells in the lining epithelium of the intestinal villi (Radostits *et al*., 2009).

In the present study, there was significant decrease (p<0.01) in serum bicarbonate concentration in diarrhoeic calves as compared to healthy calves. Similar findings were also reported in past by Kamal (2008) and Nayak *et al.* (2019) during their study on calf diarrhoea. Lower levels of serum bicarbonate in affected calves might be attributed to loss of water and electrolytes including bicarbonate in diarrhoeic faeces (Dewell and Cooper, 2016).

Conclusions

In the present study, significant alterations were observed in most of the haemato-biochemical and electrolyte parameters of neonatal cattle calves affected with diarrhoea. These variations might be associated with various metabolic disturbances occurred due to diarrhoea, and can be used to assess the severity of disease and monitoring during treatment in affected calves.

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