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RESEARCH ARTICLE

A study on alteration in Haemato-biochemical parameters in Colibacillosis affected calves

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Abstract

The objective of the present study was to evaluate haemato-biochemical changes occurred in colibacillosis affected diarrhoeic calves. The study was undertaken in calves at Cattle and Buffalo Farm at I.V.R.I, Izatnagar, during the period from September 2012 to April 2013**.** A total number of 25 diarrhoeic calves (*Escherichia coli* positive) and five clinically normal healthy calves (as control) of the same herd were taken to investigate the hemato-biochemical profiles. *E. coli* was isolated from the diarrhoeic calves and the animals found positive were used for the study of haemato-biochemical profile. Analysis of blood and serum samples of the diarrhoeic calves revealed significant increase in PCV, total serum protein, serum albumin: globulin (A:G) ratio, serum urea nitrogen, serum albumin, creatinine and potassium, while significant decrease in serum glucose, sodium and chloride were recorded. However, no significant changes were observed in haemoglobin, serum ALT, AST and globulin.

Introduction

Calf diarrhoea especially occurs in the first week of life (Azizzadeh et al., 2012) and is associated with loss of water and electrolytes that leads to an isotonic or hypotonic dehydration in diarrhoeic calves. Infectious diarrhoea in calves is most commonly associated with enterotoxigenic *Escherichia coli*, *Cryptosporidium parvum*, rotavirus, coronavirus, or some combination of these pathogens (Foster et al., 2009). Among these pathogens, Escherichia coli is the important cause of diarrhoea in neonate. The diarrhoeic calves appeared dull, depressed and lethargic with reduced appetite. The faeces were semisolid to watery with offensive odour, greenish to yellowish white in colour and sometimes even blood stained. Mild to moderate dehydration was found to be a constant feature in diarrhoeic calves. Rectal temperature, pulse and respiration rates were within the normal range (Ramkumar, 2012). The clinicohaemato-biochemical alterations in diarrhoea are complex in nature comprising of serious imbalances of fluid, electrolyte and acid base status threatening the life of the patient.

Materials and Methods

i. Animals

The present study was undertaken in calves at Cattle and Buffalo Farm at I.V.R.I, Izatnagar, in the time period from September 2012 to April 2013**.** The bovine calves taken for the study belonged to either indigenous Tharparker or Vrindavani (Cross between *Holstein Frisian*, *Brown Swiss* and Haryana) and Murrah Buffulo.

ii. Escherichia coli

E. coli was isolated from the diarrhoeic calves. Those animals found positive for *E. coli* were used for the study of haemato-biochemical profile.

iii.**Haematological and Serum Biochemical Profile**

Whole blood was collected in EDTA vials for estimation of haemoglobin (Hb), packed cell volume (PCV) and serum for biochemical analysis. The determination of Hb and PCV was done within two hours of collection. However, serum samples were stored at -20°C for further analysis. Haemoglobin concentration (g/dl) in the whole blood was estimated by cyano-methemoglobin method (Vankampen and Zinglstra, 1961**).** Packed cell volume (PCV %) was determined by capillary micro-haematocrit method (Coles, 1980).

Serum samples stored in deep freeze at –20 ^{0}C were used for estimation of the blood urea nitrogen (BUN) by diacetylmonosamine method and serum creatinine by Jaffe's alkaline picrate method (Marsh et al., 1965), serum alanine amino transferase (ALT) and serum aspartate amino transferase (AST) by Reitman and Frankel method (1957), Serum total protein (TP) by modified biuret and albumin by Dumas method (Varley et al., 1980). Serum globulin was estimated by subtracting albumin from total protein and serum albumin: globulin (A:G) ratio was estimated by dividing albumin value with globulin value. Serum glucose and serum chloride were estimated according to O'toludine method (Hultman, 1959) and thiocyanate method (Schoenfeld and Lewellen, 1964) respectively**.** Also serum sodium and serum potassium were estimated (Trinder, 1951; Miller, 1984).

Results and Discussion

The haemato-biochemical changes recorded in *E. coli* affected diarrhoeic calves (25) and control calves (5) are depicted in table 1. No significant change in haemoglobin values were observed in diarrhoeic calves but highly significant increase was recorded in the value of PCV in all the cases of calf diarrhoea (43.8±0.48%) as compared to the healthy control calves (34.08±0.4). Similarly, present findings are in accordance with those as obtained by Tenant et al.(1968) where they observed a higher value of PCV in scouring calves as compared to normal value (39.03±0.88%). Grove-White and White (1999) also observed a significantly increased value of PCV (48.4 $\pm$10.3 %) in diarrhoeic calves as compared to the non-diarrhoeic calves (33.6 ±4.3 %). Increase in PCV value in diarrhoeic calves was apparently due to hemo-concentration associated with dehydration and hypovolemia.

A significant increase in Total Serum Protein (7.74±0.08g/dl) and serum albumin (3.71±0.03g/dl) in diarrhoeic calves were observed apparently due to associated dehydration. Tenant et al., (1972), Constable et al., (1996) and Walker et al., (1998) observed the significant increase in both PCV and TSP, which indicates hypovolemia, hemo-concentration and reduced glomerular filtration rate. A significant increase in A: G ratio (0.92±0.06) was observed in diarrhoeic calves suggesting either increase in albumin, or due to dehydration (Kaneko, 1989), or decrease in globulins. No significant changes in ALT and AST activities were observed, which indicates the absence of marked hepatic damage. These results were in consistent with the findings of Lewis et al., (1975).

The marked reduction in the value of serum glucose in diarrhoeic calves (44.67±1.80 mg/dl) as compared to healthy control calves (75.13±1.57 mg/dl) was observed, which is in close agreement with Lewis et al., (1975) who observed hypoglycaemia with glucose concentration below 40 mg/dl of plasma in acute severe diarrhea. Grove-White and White (1999) observed a reduced glucose level of 4.87(1.9) mmol/L in diarrhoeic calves as compared to the non-diarrhoeic control calves having glucose level 5.8(0.88) mol/L. Morris et al. (1985) suggested that severe hypoglycaemia may occur as a result of reduced rate of conversion of lactic acid to glucose. Other

factors involved in causing hypoglycaemia in diarrhoeic calves may include anorexia, decreased intestinal absorption of glucose (Bywater et al., 1969; Bywater, 1977), a low level of glucose reserves at this age (Shelly, 1969) and alternation in tissue metabolism caused by decreased blood flow and oxygenation associated with hypovolemic shock (Tenant et al., 1972) which has been invariably present in hypoglycaemic diarrhoeic calves.

A significant decrease in the level of serum sodium in diarrhoeic calves (109.23±2.68 mmol/L) was recorded against the normal healthy calves (141.94±1.24 mmol/L). These findings are in agreement with the findings of Sridhar et al., (1988), Maach et al., (1992), Aly et al., (1996) and Grove-White and White, (1999). Hyponatremia occurs as a result of excessive secretion of the Na^+ ions by intestinal villus cells which are lost through the intestinal tract particularly in enterotoxigenic *E. coli* induced diarrhoea (Radostits et al., 2007). Most of the diarrhoea causing microorganisms disrupt the intestinal function and dehydrate the body either by increasing the chloride-secreting activity of the crypt cell or impairing the absorption of sodium by the villus cells or both (Hirschhorn et al., 1991). Then the fluid that is normally returned to the blood across the intestinal wall is lost in the watery stool.

The present data also revealed a significant increase in serum potassium (5.11±0.13 mmol/L) in diarrhoeic calves. Similar findings were also reported by Sridhar et al., (1988) and Grove-White. (1999). Hyperkalaemia in experimentally induced diarrhoea was also observed by Roy et al., (1984), Groutides and Michell (1990), Michellet et al., (1992), Constable et al. (1996) and Walker et al. (1998). Hyperkalaemia may be due to increased potassium retention by kidney and also due to cellular damage (Fisher, 1971).

A reduced value of serum chloride was observed in diarrhoeic calves (5.11±0.13 mmol/L) as compared with the normal healthy calves (102.06±1.84 mmol/L) which is in conformity with data as reported by many workers (Hartmann et al., 1983; Maach et al., 1992; Aly et al., 1996). However, the present findings are contradictory to the reports of some previous studies in which hyperchloraemia have been observed in diarrhoeic calves (Magdolna et al., 1976; Sridhar et al., 1988). Hyperchloraemia was reported to occur as a result of prolonged increased loss of Cl^- ions in the intestinal tract during diarrhoea (McSherry and Grinyer, 1954; Radiosits et al., 2007), and failure of gastric H^+ and Cl^- ions to be reabsorbed by the villi of small intestine (Radostits et al., 2007).

A moderate increase in serum urea nitrogen in diarrhoeic calves (27.4±0.60 mg/dl) was recorded as compared to control (19.87±0.95mg/dl) and increased serum creatinine values were also recorded in diarrhoeic calves (1.68±0.03 mg/dl) against the healthy control calves (0.69±0.05 mg/dl). An increase in both the parameters was in consistent with the report by many researchers (Groutide and Michell 1990a; Michellet al., 1992; Constable et al., 1996; Walker et al., 1998; Grove-White, 1999). Tenant et al., (1972) observed a significant increase in BUN of 50.1±18.5mg/dl in calves with acute enteric infection while Grove-White and White (1999) recorded a significant increase in urea level as 13.9±7.1 mmol/L in diarrhoeic calves against the value of non-diarrhoeic control calves, (3.3±0.8 mmol/L). Similarly, a significant increase in creatinine level of 221 ±129.5 mmol/L was also observed in diarrhoeic calves as compared to non-diarrhoeic control calves, (101±13.7 mmol/L). The significant increase in serum urea nitrogen and creatinine in the present study was attributable to dehydration as a result of diarrhoea. The hypovolemia due to dehydration results in concentration of the plasma solutes with proportionate increase in both the parameters. However, such cases of pre-renal azotaemia need to be differentiated from other conditions including decreased peripheral vascular perfusion. Further, in case of hypovolemia, impaired excretion of urea and creatinine may occur, secondary due to reduced renal blood flow and GFR (glomerular filtration rate). Tenant et al. (1972) demonstrated varying degrees of renal insufficiency in calves with severe diarrhoeal diseases. They believed that renal insufficiency was caused primarily by decreased blood flow (pre-renal azotemia) as commonly observed by many workers in diarrhoeic calves (Groutides and Michell, 1990a and Bouda et al., (1987). Haemato-biochemical changes recorded in Colibacillosis affected diarrhoeic calves in the present study may be useful for treatment of calf diarrhea as it is the most common cause in neonatal calves.

Table No.1: Haemato- biochemical changes in healthy and diarrhoeic calves

Parameters	**Healthy control calves (n =5)**	**Diarrhoeic calves (n= 25)**
Hb(g%)	12.76±0.08	12.64±0.18
PCV (%)	34.08±0.4	43.8±0.48**
Total protein (g/dl)	7.16±0.07	7.74±0.08**
Albumin (g/dl)	3.23±0.07	3.71±0.03**
Globulin (g/dl)	3.93±0.19	4.03±0.11
A:G ratio	0.82±0.07	0.92±0.06*
Glucose (mg/dl)	75.13±1.57	42.48±1.96**
Creatinine (mg/dl)	0.69±0.05	1.68±0.03**
Urea nitrogen (mg/dl)	19.87±0.95	27.4±0.60**
Sodium (mmol/L)	141.94±1.24	109.23±2.68**
Potassium (mmol/L)	4.32±0.08	5.11±0.13**
Chloride (mmol/L)	102.06±1.84	95.11±2.19**
ALT (U/L)	38.88±1.22	38.92±1.159
AST(U/L)	16.47±1.01	16.34±0.97

* Significant at $p<0.05$, ** Significant at $p<0.01$

Conclusion

Analysis of blood and serum samples of the diarrhoeic calves revealed significant increases in PCV, TSP, serum A: G ratio, serum urea nitrogen, serum albumin, creatinine and potassium and significant decreases in serum glucose, sodium and chloride. As regards haemoglobin, serum ALT, AST and globulin, no significant alteration were observed between the diarrhoeic calves and healthy control calves.

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Competing interests

The authors declare that they have no competing interests.

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