CLINICAL AND HAEMATO-BIOCHEMICAL STATUS FOLLOWING CRYSTALLOID AND COLLOID FLUID THERAPY IN DYSTOCIA AFFECTED BUFFALO SUBJECTED TO OBSTETRICAL MANEUVERING

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Received: 06.09.2016 Accepted: 15.10.2016

ABSTRACT

The impact of crystalloid (Normal or Hypertonic saline) and colloid (Dextran-40 or Polygeline) based fluid therapies on clinical and haemato-biochemical status as well as survival rate of 24 dystocia-affected buffalo subjected to obstetrical maneuvering was assessed. Depending upon fluid therapy administered, the buffalo were divided (n=6 each) into groups namely, group NSS (Normal saline solution 5-10 L, i.v.), group H+O (7.2% Hypertonic saline solution, HSS @ 4 ml/kg b wt, i.v. + Oral fluid/freshwater @ 40 ml/kg b wt), group D+H+O (Dextran-40 @ 20 ml/kg b wt, i.v. + HSS + Oral fluid) and group P+H+O (Polygeline @ 20 ml/kg b wt, i.v. + HSS + Oral fluid). Blood samples following delivery of fetus were collected immediately before the start (0 h) and at 6, 12 and 24 h after the start of fluid therapy. Heart rate decreased ($p<0.05$) in groups H+O and D+H+O. Capillary refill time, degree of dehydration and packed cell volume decreased ($P<0.05$) at 24 h in groups D+H+O and P+H+O. Rectal temperature, respiratory rate and peripheral pulse rate exhibited no variation ($P>0.05$). The decline ($P<0.05$) in blood glucose was better in groups D+H+O and P+H+O as compared to groups NSS and H+O. Plasma creatinine, blood urea nitrogen and plasma proteins had no variation ($P>0.05$) during post-fluid therapy period. In group P+H+O, plasma sodium decreased ($P<0.05$) and plasma potassium increased ($P<0.05$) by 24 h after fluid therapy, whereas, plasma chloride remained unchanged ($p>0.05$). The dam survival rate was better in colloid compared to crystalloid-based fluid therapies (83.3-100% *vs.* 66.6%, respectively). In conclusion, colloid-based fluid therapy was more effective for the resuscitation of buffalo subjected to obstetrical maneuvering.

Keywords: Buffalo, Dystocia, Fluid therapy, Haemato-biochemical, Obstetrics

INTRODUCTION

Dystocia is a major reproductive disorder in buffalo in which dehydration and the development of post-operative toxemia is a major reason for their failure to survive (Dhindsa *et al.,* 2005). The recorded alterations in blood parameters are suggestive of deteriorating condition of dam and thus help to decide about the institution of various therapies like electrolyte therapy (Ghuman, 2010). Intravascular volume expansion using appropriate fluid therapy is the fundamental goal in the clinical management of toxemic and hypovolemic dystocia affected buffalo. Administration of large amount of oral fluid (fresh water) along with small amount of intravenous hypertonic saline both with or without Dextran-40 was tried and yielded desirable results in toxemic calves (Singh *et al.,* 2004). Hence, the present study was planned to evaluate the impact of different fluid therapies on clinical and haemato-biochemical status as well as survival rate of dystocia-affected buffalo.

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MATERIALS AND METHODS

On the basis of complete history with regard to age, parity, stage of gestation, duration of labor, previous handling and medication of the animals, 24 buffalo suffering from dystocia (except uterine torsion) and relieved by obstetrical procedures such as mutation and/or fetotomy were included in the present study. Following obstetrical management, these animals were divided into groups namely, group NSS

(Normal saline solution 5-10 L, i.v.), group H+O (7.2% Hypertonic saline solution, HSS @ 4 ml/kg b wt, i.v. + Oral fluid/freshwater @ 40 ml/kg b wt), group D+H+O (Dextran-40 @ 20 ml/kg b wt, i.v. + HSS + Oral fluid) and group P+H+O (Polygeline @ 20 ml/kg b wt, i.v. + HSS + Oral fluid). The fluid therapy was initiated in all the buffalo within 30 min after the delivery of fetus following obstetrical maneuvering.

Before the start of fluid therapy, 10 ml blood sample by jugular venipuncture was collected in heparinized vial (2-5 IU/ml blood) and another 5 ml blood sample was collected in a vial with sodium fluoride as anticoagulant for glucose estimation. Subsequent blood sampling was carried out at 6, 12 and 24 h after the start of fluid therapy. A part of whole blood out of 10 ml sample was used for hematology estimation (Haemoglobin, Packed Cell Volume, Total Leukocyte Count) and remaining 10 ml and 5 ml sample were centrifuged at 3000 rpm for 15 min. Following centrifugation, plasma and serum was separated and stored in aliquots at -20°C until analysis of blood glucose, total plasma proteins, plasma creatinine, blood urea nitrogen and electrolytes (Na^+, K^- and Cl). Various clincial parameters were also recorded at the time of blood sampling. The comparison of different parameters between treatment groups and at different time points was done using ANOVA statistical procedure. Data was expressed as Mean±SEM and statistical analysis was conducted using IBM SPSS statistics 21.0 windows.

RESULTS AND DISCUSSION

The rectal temperature, respiration rate and peripheral pulse rate following obstetrical management of dystocia-affected buffalo exhibited no variation subsequent to administration of various fluid therapies (P<0.05, Table 1). This suggested that these parameters are not influenced by crystalloids and colloids administered to dystocia-affected buffalo. Nevertheless, in a previous study, the animals treated for dystocia exhibited a rise in body temperature due to endotoxemic infections. However, in the present study, no such variation in rectal temperature was observed (P>0.05; Table 1). Moreover, a significant reduction in respiratory rate was recorded about 12h after the administration of NSS or HSS+Dextran in diarrhoeic calves (Senturk, 2003). The heart rate recorded at the start of fluid therapy continued to decrease in the subsequent period of 24 h with appreciable decrease in groups H+O and D+H+O (P<0.05, Table 1). This could be the result of hyperosmotic saline infusion that increases dynamic efficiency of circulatory system (Constable *et al.,* 1991). Furthermore, the buffalo of all the groups had compromised hemodynamic system, as suggested by delayed capillary refill time (>2 sec) at the start of fluid administration (Table 1). In fact, the capillary refill time is one of the clinical variables used as an indicator of degree of dehydration. Nevertheless, in the buffalo subjected to obstetrical maneuvering, both capillary refill time and degree of dehydration were decreased by 24 h after the start of fluid therapy in all the groups (P<0.05, Table 1). Almost all the fluid therapies were equipotent in restoring the capillary refill time to <2 sec during the course of study (P<0.05, Table 1). However, as compared to gp NSS, the decrease in capillary refill time and dehydration status was much better in groups D+H+O and P+H+O (P<0.05, Table 1). The infusion of HSS along with Dextran or Polygeline decreases edema in endothelial cells in blood vessels causing pre-capillary dilatation and decreasing vascular resistance (White, 1996). The colloidal solutions such as dextran are extremely effective volume expanders due to their ability to increase colloidal osmotic pressure, and are used for fluid resuscitations in hypovolemic patients like cattle, horses and dogs (Jones *et al.,* 2001).

In dystocia-affected buffalo, the packed cell volume was above the normal limit of 31% after obstetrical maneuvering and before the initiation of fluid therapy (Table 2). During dystocia, the loss of fluid causes decrease in plasma and blood volume, however, intravenous fluid treatment after relieving dystocia compensates the lost plasma fluid (Dhindsa *et al.,* 2005). Compared to packed cell volume at the start of fluid therapy, the values decreased by 24 h after fluid therapy in groups D+H+O and P+H+O (P<0.05, Table 2). The decrease in packed cell volume following colloid based fluid administration might be due to the greater expansion of plasma volume (Mitra and Khandelwal, 2009). Other hematological parameters namely hemoglobin and total leukocyte count had no variation at different time intervals of present study period in buffalo administered various fluid therapies (P>0.05, Table 2). The absence of variation in total leukocyte count over the time period of the present

Table 1: Impact of fluid therapy on clinical parameters of dystocia affected buffalo (n=6 in each group) **subjected to obstetrical maneuvering.** N, Normal saline solution; H, Hypertonic saline solution; O, Oral fluid; D, Dextran-40; P, Polygeline

Parameter	Group	Before the start of fluid therapy	Hours after the start of fluid therapy		
		0	6	12	24
Rectal temperature, ºF	**N**	99.8±0.5	100.1±0.3	100.3±0.5	100.2±0.4
	H+O	100.3±0.4	100.5±0.3	100.6±0.3	100.4±0.2
	D+H+O	101.3±0.7	101.0±0.7	100.7±0.4	100.9±0.3
	P+H+O	101.2±0.5	101.0±0.4	100.5±0.3	100.6±0.3
Respiration rate, breaths/ min	**N**	32.3±0.7	31.5±1.0	31.2±0.8^{a}	30.0±0.7
	H+O	32.3±2.2	30.5±2.2	29.3±1.1^{ab}	28.0±0.9
	D+H+O	31.5±1.7	30.2±0.8	29.7±0.4^{ab}	28.2±0.9
	P+H+O	29.7±1.8	30.0±0.6	28.2±0.6^{b}	28.3±0.7
Heart rate, beats/ min	**N**	63.8±3.3	66.0±1.3	64.5±1.0	62.8±0.7
	H+O	69.7±2.3^{A}	66.3±1.2^{AB}	63.0±0.7^{BC}	61.8±0.7^{C}
	D +H+O	67.0±1.6^{A}	65.7±1.5^{AB}	63.7±1.2^{AB}	62.2±1.0^{B}
	P+H+O	65.8±2.4	64.0±1.7	63.5±1.0	64.3±0.7
Peripheral Pulse rate, beats/min	**N**	58.3±2.4	58.5±1.3	60.5±0.6	59.2±0.6
	H+O	57.7±1.5	59.2±1.0	59.7±1.1	58.3±0.8
	D+H+O	59.7±1.8	58.3±1.7	60.3±0.7	60.2±1.7
	P+H+O	58.8±2.6	56.7±1.8	59.7±0.8	59.7±0.6
Capillary refill time, sec	**N**	2.8±0.3^{A}	2.0±0.3^{AB}	2.3±0.3^{a,AB}	1.8±0.2^{B}
	H+O	2.5±0.4^{A}	2.2±0.3^{AB}	1.7±0.2^{ab,AB}	1.5±0.2^{B}
	D +H+O	2.5±0.3^{A}	1.5±0.2^{B}	1.7±0.2^{ab,B}	1.5±0.2^{B}
	P+H+O	2.5±0.4^{A}	1.5±0.2^{B}	1.3±0.2^{b,B}	1.5±0.2^{B}
Degree of dehydration, sec	**N**	6.0±0.4^{A}	5.7±0.5^{a,AB} [-5.0]	4.7±0.2^{a,BC} [-21. 7]	4.0±0.3^{a,C} [-33.3]
	H+O	6.5±0.4^{A}	6.1±0.4^{a,A} [-6.1]	4.0±0.4^{a,B} [-38.7]	2.5±0.4^{b,C} [-61.5]
	D+H+O	6.0±0.6^{A}	4.7±0.4^{b,B} [-21.5]	2.7±0.2^{b,C} [-55.4]	1.3±0.3^{c,D} [-78.3]
	P+H+O	6.0±0.4^{A}	4.8±0.3^{b,B} [-20.8]	2.8±0.3^{b,C} [-53.6]	1.2±0.2^{c,D} [-80.0]

Values with different superscripts differ (P<0.05) within a row (A, B, C) or for a parameter within a column (a, b, c). Values in parenthesis […] indicate percent change from data before the start of fluid therapy in each group.

study reflects the absence of infection following obstetrical management of dystocia. Nevertheless, in a study, the total leucocyte count deceased after fluid therapy and was attributed to a decrease in circulating corticosteroids due to alleviation of stress after obstetrical treatment and fluid therapy (Saxena *et al.,* 2007).

The above normal (>49-77 mg/dl) blood glucose observed at the start of fluid therapy (Table 3), indicated the presence of severe stress due to dystocia and subsequent obstetrical manipulations. Similar results regarding blood glucose following various obstetrical procedures were reported previously (Kumar *et al.,* 2009). Nevertheless, during the post-treatment period, the decrease (P<0.05; Table 3) in blood glucose suggested the removal of stress (Ghuman *et al.,* 1996). However, this decline was better in buffalo administered dextran or polygeline as compared to NSS or H+O fluid (P<0.05, Table 3). At the start of present study, plasma creatinine and blood urea nitrogen were elevated (Table 3) as compared to normal values (1.7 mg/dl and 15.5 mg/dl, respectively). Also, in a previous study, higher plasma creatinine and blood urea nitrogen was reported in dystocia-affected buffalo (Dhindsa *et al.,* 2005). In a previous study in dystocia-affected buffalo, plasma urea was increased following HSS administration containing dextran (Kumar *et al.,* 2009). However, in the present study, plasma creatinine and blood urea nitrogen exhibited no variation at different time points of post-fluid therapy period (P>0.05, Table 3). Plasma protein was lower at the start of the present study (Table 3) as compared to normal values (6.8-7.7 g/dl). Following NSS or H+O fluid therapy, the plasma proteins remained unchanged (P>0.05), however, buffalo administered dextran or polygeline with H+O exhibited an increase (P<0.05) in plasma protein by 24 h after the start of fluid therapy (Table 3). This increase could be attributed partially to alleviation of stress, decreased protein catabolism and decreased inflammation (Ghuman *et al.,* 1996). In addition, dextran and polygeline are colloids that can hold proteins inside the blood vessels (Constable *et al.,* 1991).

Table 2. Impact of fluid therapy on hematological parameters of dystociac buffalo (n=6 in each group) **subjected to obstetrical maneuvering.** N, Normal saline solution; H, Hypertonic saline solution; O, Oral fluid; D, Dextran-40; P, Polygeline

Parameter	Group	Before start of fluid therapy	Hours after the start of fluid therapy		
		0	6	12	24
Packed cell volume, %	**N**	37.7±1.9	40.8±1.3	40.0±1.0	39.1±0.7[a]
	H+O	39.3±2.2	40.0±1.2	39.2±0.6	39.1±0.5[a]
	D+H+O	42.2±1.1[A]	41.0±0.8[A]	40.0±0.4[AB]	39.7±0.7[a,B]
	P+H+O	40.5±1.7[A]	39.3±1.1[AB]	38.3±0.5[AB]	36.7±0.5[b,B]
Hemoglobin, g/dl	**N**	10.3±0.5	9.8±0.5[a]	9.8±0.3[a]	9.3±0.4[a]
	H+O	12.3±0.6	11.8±0.4[b]	12.0±0.5[b]	11.3±0.5[b]
	D+H+O	11.7±0.7	11.5±0.4[b]	11.5±0.5[b]	11.7±0.7[b]
	P+H+O	11.8±0.8	11.8±0.8[b]	12.0±0.7[b]	11.9±0.7[b]
Total leucocyte count, ×1000 / cumm	**N**	9.4±0.4	9.8±0.3	9.3±0.4	9.5±0.4
	H+O	10.3±0.6	10.5±0.5	10.2±0.5	10.0±0.4
	D+H+O	9.8±0.6	8.2±1.4	10.5±0.6	10.8±0.6
	P+H+O	10.1±0.6	9.7±0.4	10.8±0.6	10.7±0.6

Values with different superscripts differ (P<0.05) within a row (A, B, C) or for a parameter within a column (a, b, c)

Table 3. Impact of fluid therapy on blood/plasma biochemical parameters of dystocia affected buffalo (n=6 in each group) **subjected to obstetrical maneuvering**. N, Normal saline solution; H, Hypertonic saline solution; O, Oral fluid; D, Dextran - 40; P, Polygeline

Parameter	Group	Before start of fluid therapy	Hours after the start of fluid therapy		
		0	6	12	24
Blood Glucose, mg/dl	**N**	136.1 ± 15.0^{A}	$100.8 \pm 9.6^{ab,AB}$	$97.5 \pm 14.1^{ab,AB}$	96.0 ± 12.5^{B}
	H+O	136.2 ± 17.0^{A}	$89.1 \pm 14.1^{b,B}$	$78.9 \pm 7.1^{b,B}$	74.8 ± 5.0^{B}
	D+H+O	162.1 ± 17.3^{A}	$132.2 \pm 12.6^{a,B}$	$91.2 \pm 5.3^{ab,C}$	87.0 ± 7.0^{C}
	P+H+O	154.3 ± 14.3^{A}	$109.9 \pm 8.6^{a,B}$	$103.6 \pm 11.1^{a,B}$	82.2 ± 7.4^{C}
Creatinine, mg/dl	**N**	2.19±0.35	1.70±0.16	1.65±0.30	1.56±0.44
	H+O	2.15±0.15	1.68±0.09	1.60±0.21	1.53±0.21
	D+H+O	2.76±0.25	1.54±0.27	1.11±0.34	1.07±0.37
	P+H+O	2.10±0.20	1.30±0.24	1.26±0.21	1.19±0.12
Blood Urea Nitrogen, mg/dl	**N**	24.48±4.71	23.03±4.15	23.01±4.86	26.60±4.38
	H+O	19.41±2.02	20.43±1.15	23.01±2.93	23.38±2.53
	D+H+O	23.00±2.99	21.63±3.81	25.18±4.11	28.28±4.48
	P+H+O	23.89±2.00	24.55±2.71	26.49±2.99	28.84±4.79
Total plasma protein, g/dl	**N**	6.1±0.4	6.3±0.4	6.1 ± 0.1^{a}	5.9 ± 0.3^{b}
	H+O	5.8±0.4	5.6±0.3	5.5 ± 0.2^{b}	5.6 ± 0.3^{b}
	D+H+O	5.6 ± 0.4^{A}	6.2 ± 0.5^{A}	$6.8 \pm 0.5^{a,A}$	$7.2 \pm 0.4^{a,B}$
	P+H+O	5.7 ± 0.4^{A}	5.9 ± 0.2^{A}	$6.4 \pm 0.2^{a,AB}$	$6.6 \pm 0.2^{ab,B}$
Sodium, m. Eq/L	**N**	164.5 ± 5.0^{a}	156.9±4.8	135.2±17.6	130.7 ± 2.8^{b}
	H+O	147.0 ± 2.5^{b}	147.6±2.5	146.4±2.7	145.2 ± 3.1^{a}
	D+H+O	$168.5 \pm 6.3^{a,A}$	156.5 ± 6.1^{AB}	151.1 ± 4.8^{BC}	$139.2 \pm 3.1^{a,C}$
	P+H+O	$160.7 \pm 5.2^{ab,A}$	154.3 ± 5.1^{A}	148.3 ± 3.7^{AB}	$138.6 \pm 3.4^{a,B}$
Potassium, m. Eq/L	**N**	4.70±0.31	4.76±0.25	5.14±0.46	5.52±0.36
	H+O	5.42±0.45	5.34±0.40	5.32±0.22	5.38±0.26
	D+H+O	5.57±0.50	5.21±0.31	5.68±0.34	5.93±0.17
	P+H+O	4.93 ± 0.32^{A}	4.96 ± 0.31^{A}	5.24 ± 0.19^{AB}	5.80 ± 0.25^{B}
Chloride, m. Eq/L	**N**	107.7±2.3	105.5±1.8	105.4±2.2	103.6±2.6
	H+O	103.9±1.3	102.6±1.6	102.1±1.2	99.8±1.3
	D+H+O	104.0±1.7	102.5±1.4	101.5±1.3	100.6±1.0
	P+H+O	104.0±1.1	102.0±1.0	102.0±1.0	101.3±1.2

Values with different superscripts differ (P<0.05) within a row (A, B, C) or for a parameter within a column (a, b, c)

In the present study, before the start of fluid therapy, plasma sodium and chloride were higher and plasma potassium was lower than normal values (144, 6.1 and 94 m. Eq/L respectively) as reported in buffalo (Canfield *et al.,* 1984). In colloid (especially polygeline) administered groups, plasma sodium exhibited a decrease (P<0.05) and plasma potassium an increase (P<0.05) by 24 h after the end of fluid therapy, whereas, plasma chloride concentrations remained unchanged (P>0.05; Table 3). On the other hand, the absence of variation in plasma electrolytes was recorded over the study period in buffalo administered crystalloid solutions (P>0.05, Table 3). In present study, the decrease in plasma electrolytes might have occurred due to renal filtration under the influence of fluid administered. It was suggested that hypertonic saline causes excretion of plasma sodium and plasma chloride through increased renal excretion (Constable *et al.,* 1991). The reason behind lower plasma potassium at start of fluid treatment could be dystocia induced anorexia and urinary loss of plasma potassium (Peek, 2000). However, following fluid therapy containing Polygeline, the plasma potassium was restored to normal (Table 3).

All the buffalo of the present study survived until the end of sampling period however, the mortality was recorded through follow-up of cases. Out of six buffalo in each group, two buffalo failed to survive in each of the groups in which intravenous NSS or H+O fluid was administered. One buffalo died in the group administered Polygeline with H+O fluid, whereas all the buffalo survived in the group administered Dextran-40 with H+O fluid. Comparatively better increased rate of dam survival in buffalo administered Dextran or Polygeline with H+O fluid could be due to better alleviation of stress as indicated in clinical parameters and restoration of hemato-biochemical parameters to normal.

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