CRYSTALLOID AND COLLOID FLUID THERAPY FOR MAINTAINING THE PLASMA AND BLOOD VOLUME IN BUFFALO SUBJECTED TO OBSTETRICAL MANEUVERING

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ABSTRACT

The impact of crystalloid (Normal or Hypertonic saline) and colloid (Dextran-40 or Polygeline) fluid therapies on dehydration status of twenty-four dystocia affected buffalo subjected to obstetrical maneuvering was monitored through plasma and blood volume evaluation. Depending upon the fluid therapy administered, the buffalo were divided (n=6 each) into groups namely, 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 were collected following the delivery of fetus, before the start of fluid therapy (0 h) and at 6, 12 and 24 h after the start of fluid therapy. The buffalo receiving intravenous NSS or HSS+Oral fluid exhibited a less persistent increase ($p<0.05$) in plasma and blood volume after the start of fluid therapy (till 6 and 12 h, respectively). However, the increase ($p<0.05$) in plasma and blood volume persisted till 24 h following the addition of colloids in the crystalloid fluid therapy (HSS+Oral fluid). In brief, colloids can be used to maintain the plasma and blood volume over a longer period of time in buffalo subjected to obstetrical maneuvering.

Keywords: Buffalo, Colloid, Crystalloid, Dystocia, Blood Volume

INTRODUCTION

Intravascular volume expansion using appropriate fluid therapy is a fundamental goal in the clinical management of toxemic and hypovolemic animals (Dhindsa *et al.,* 2007). The delay in treatment of dystocia can lead to decrease in blood and plasma volume followed by dam mortality up to 70% (Ghuman, 2010). In fact, the variable degree of dehydration in dystocia affected buffalo requires therapies for improving their hemodynamic status and prevent the buffalo from going into shock of toxemic, hypovolemic or haemorrhagic origin (Kumar *et al.,* 2009). Therefore, the present study was planned with the objective to evaluate the impact of different fluid therapies consisting of crystalloids (Normal or Hypertonic saline) and colloids (Dextran-40 or Polygeline) on the hemodynamic status (plasma and blood volume) of buffalo subjected to obstetrical maneuvering.

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 buffaloes suffering from dystocia (except uterine torsion) and relieved by obstetrical procedures were included in the present study. The animals were divided into group NSS (Normal saline solution, 5-10 L, i.v., n=6), group H+O (7.2% Hypertonic saline solution, HSS @ 4 ml/kg b wt, i.v. + Oral fluid/fresh water @ 40 ml/kg b wt, n=6), group D+H+O (Dextran-40 @ 20 ml/kg b wt, i.v. + HSS + Oral fluid, n=6) and group P+H+O (Polygeline @ 20 ml/kg b wt, i.v. + HSS + Oral fluid, n=6). Blood samples were collected immediately after the delivery of fetus, before the start of fluid therapy (0 h) and at 6, 12 and 24 h after the start of fluid therapy. For plasma and blood volume estimation, Evan's blue dye @ 0.25 mg

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/kg body weight was administered intravenously and about 10 minutes post-dye administration, 10 ml blood sample was drawn from the opposite side jugular vein in heparinized vial. Following centrifugation at 3,000 rpm for 15 minutes, plasma and serum was separated and stored in aliquots at -20°C until analysis. The plasma volume was estimated on the basis of dye (Evan's blue dye) dilution technique and the blood volume was derived from plasma volume by an equation where Blood volume was equal to plasma volume divided by 1 hematocrit (Dhindsa *et al*., 2007 and Kumar *et al*., 2009). The data between treatment groups at different time points was analyzed statistically using ANOVA procedures. Data was expressed as Mean±SEM and the statistical analysis was conducted using IBM SPSS statistics 21.0 windows.

RESULTS AND DISCUSSION

The plasma and blood volume in the dystocia affected buffalo following obstetrical treatment ranged between 46-51 and 67-72 ml/kg b wt, respectively (Table 1). This suggested the existence of dehydration in dystocia affected buffalo, and the need of immediate fluid therapy. In the present study, the buffalo in which intravenous normal saline or hypertonic saline along with oral fluid was administered exhibited a less persistent increase ($p<0.05$, till 6 and 12 h after the start of fluid therapy, respectively) in plasma and blood volume (Table 1), as reported previously (Kumar *et al.,* 2009). However, the increase ($p<0.05$) in plasma and blood volume observed immediately after the end of colloid fluid therapy persisted till 24 h (Table 1)**.** Thus, a less persistent increase in crystalloid (normal saline or hypertonic saline) administered buffalo as compared to colloid (Dextran-40 or Polygeline) treated buffalo was due to the shorter half-life of crystalloid solutions (St Jean *et al.,* 1993). Dextran-40 is a colloidal solution which is extremely effective volume expander to reduce blood viscosity and blood cell sludging which improves microcirculation (Webb, 1982 and Tollofsrud *et al.,* 2001). However, there is no comparative study available on the evaluation of Dextran and Polygeline for the fluid replacement therapy. A study that sought to compare Polygeline and Ringer's solution therapy following coronary artery bypass surgery found that Polygeline requires less volume and achieves better filling of circulation compared to Ringer's solution (Wahba *et al.,* 1996). Polygeline being a gelatin product do not accumulate in the body due to increased activity of proteolytic enzymes and does not seem to impair hemostasis as compared to other colloidal solution (Adukauskiene *et al.,* 2009). Another

Table 1. Impact of fluid therapy on plasma and blood volume 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

	Group	Before the start of fluid therapy	Hours after the start of fluid therapy		
		0	6	12	24
Plasma volume (ml/kg b wt)	NSS	46.6 ± 1.3^{A}	$51.1\pm1.3^{a,B}$	$46.4\pm1.1^{a,A}$	$44.0\pm0.8^{a,A}$
	H+O	51.0 ± 2.1^{A}	$59.8\pm2.1^{a,B}$	$58.0\pm1.5^{b,B}$	$54.4\pm1.5^{b,AB}$
	D+H+O	48.1 ± 1.4^{A}	$64.1\pm2.5^{b,BC}$	$67.2\pm2.5^{c,C}$	$59.8\pm2.1^{c,B}$
	P+H+O	48.5 ± 1.5^{A}	$63.3\pm1.9^{b,BC}$	$67.1\pm2.4^{c,C}$	$58.6\pm1.9^{bc,B}$
Blood volume (ml/kg b wt)	NSS	68.3 ± 2.8^{A}	$72.4\pm1.5^{a,B}$	$64.8\pm1.3^{a,A}$	$63.1\pm1.3^{a,A}$
	H+O	72.3 ± 2.6^{A}	$85.8\pm4.5^{b,B}$	$81.9\pm1.9^{b,B}$	$77.0\pm2.0^{b,AB}$
	D+H+O	70.0 ± 1.9^{A}	$95.3\pm3.7^{b,C}$	$96.1\pm3.7^{c,C}$	$98.1\pm2.8^{c,B}$
	P+H+O	67.2 ± 2.4^{A}	$91.6\pm2.5^{b,C}$	$95.8\pm3.1^{c,C}$	$97.0\pm2.4^{c,B}$

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

study that compared volume replacement properties of Haemaccel (Polygeline) and whole blood found that Haemaccel resulted in higher cardiac output, lower blood viscosity, and decreased peripheral arteriolar resistance as compared to whole blood (Hilzenrat *et al.,* 2001).

In the present study, hypertonic saline was administered along with oral fluid to maintain an osmotic balance between circulatory and ruminal pool. The movement of water across the rumen wall due to hypertonic saline results in an increase in plasma osmolality, therefore, fluids have to be administered orally to maintain the ruminal fluid osmolality (Constable, 1999). When plasma osmolality exceeds rumen osmolality by 20 mOsm/L, this osmolal gradient induces a net water flow from rumen to plasma @ 33 ml/min/L of rumen volume. Thus, the hypertonic saline produced its resuscitative effect by rapidly increasing plasma volume by moving water from rumen and also by borrowing free water from intracellular space (Constable, 1999). The phenomenon was augmented by adding Dextran-40 or Polygeline to the hypertonic saline solution. The persistent elevation in plasma and blood volume following oral fluid and intravenous hypertonic saline is due to simultaneous intravenous administration of colloids like Dextran-40 and Polygeline, which increase the plasma osmotic pressure and maintain the mobilized fluid in the intravascular space (Walker *et al.,* 1998).

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