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Research Article

CLINICO-HAEMATO-BIOCHEMICAL STUDIES ON DIFFERENT ANAESTHETIC COMBINATIONS IN BUFFALOES UNDERGOING DIAPHRAGMATIC HERNIORRHAPHY

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ABSTRACT

A study was conducted on 18 buffaloes undergoing diaphragmatic herniorrhaphy, categorized into three groups of six animals each. Different analgesics such as pentazocine lactate, butorphanol tartrate or dipyrone were used in combination with glycopyrrolate-xylazine-ketamine. In group I, significant increase in plasma chloride was observed after pentazocine administration and the values remained elevated at recovery in comparison to the base value. In group II, plasma albumin showed a non-significant increase after 15 min of butorphanol administration and a non-significant decrease at recovery. The values of all other biochemical parameters fluctuated non-significantly within the normal physiological range in all three groups.

Key words: Butorphanol tartrate, buffalo, diaphragmatic herniorrhaphy, dipyrone, haemato-biochemical, pentazocine lactate .

Diaphragmatic hernia is a serious digestive disorder of buffaloes. It involves a rupture in the diaphragm at the musculo-tendinous junction with subsequent herniation of the abdominal organs into the thoracic cavity (Singh *et al*., 2006). It is a critical condition, as if it remains untreated causes death in 100% cases (Krishnamurthy *et al*., 1985). Treatment of disease requires two surgical procedures which are lapro-rumenotomy and diaphragmatic herniorrhaphy (DH). Repair of the diaphragmatic defect is done under general anaesthesia along with controlled ventilation (Singh *et al.,* 2006). Initial studies on DH repair reported use of a combination of chloral hydrate and thiopental sodium (Singh *et al.,* 1977), where deep sedation was achieved with chloral hydrate, and induction and maintenance with thiopentone sodium.

Opioids and non-steroidal anti-inflammatory drugs (NSAIDs) are commonly used for the treatment of pain and also employed as preemptive analgesics as an adjunct to various anaesthetic combinations in dogs and cats. However, only a few reports are available about their use and efficacy in different anaesthetic combinations in buffaloes and thus their safety and effects on various physiological parameters of body are largely unknown. In the present study, two opioids namely pentazocine lactate and butorphanol tartrate and a NSAID 'dipyrone' were used with an anaesthetic combination 'glycopyrrolate-xylazine-ketamine' in adult buffaloes undergoing DH to determine their safety.

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MATERIALS AND METHODS

The present clinical study was conducted on 18 buffaloes suffering from DH, randomly divided into three groups of six animals each. The drug protocols planned for evaluation in different groups were glycopyrrolate-xylazine-pentazocine-ketamine (GXPK/Group I), glycopyrrolate-xylazine-butorphanol-ketamine (GXBK/Group II) and glycopyrrolate-xylazine-dipyrone-ketamine (GXDK/Group III). At first glycopyrrolate was given @ 0.01 mg/kg i.m. followed by xylazine @ 0.04 mg/kg i.m. after 20 min. Pentazocine lactate @ 0.75 mg/kg i.v. or butorphanol tartrate @ 0.075 mg/kg i.v. or dipyrone @ 35 mg/kg i.v. was injected 20 min after administration of xylazine. Finally, ketamine hydrochloride @ 2 mg/kg i.v. was administered 15 min after analgesics in all groups.

Rectal temperature, heart rate and respiration rate along with the ambient temperature were recorded 15 min before the administration of glycopyrrolate to form the base values. Blood samples were collected just before administration of glycopyrrolate, 15 min after administration of butorphanol/pentazocine/dipyrone, five min after administration of ketamine, after complete recovery from the effects of the drugs and at 24 h after recovery. Physiological parameters were

recorded at these time intervals. Blood samples were collected in two sets of heparinized (10 units/ml) test tubes (one set was used for harvesting plasma for biochemical parameters and the other set to determine haematological parameters) and one set of test tube containing sodium fluoride solution (3.8%) for determining plasma glucose (1:10). The haemato-biochemical parameters investigated were haemoglobin (Hb), packed cell volume (PCV), plasma glucose, urea nitrogen, creatinine, total proteins, albumin, inorganic phosphorus, calcium (Ca), magnesium (Mg), sodium, potassium, chloride, cholesterol, alanine transaminase (ALT), aspartate transaminase (AST), alkaline phosphatase (ALKP) and bilirubin. The statistical analysis of data was done by one-way-analysis of variance and Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Clinico-physiological Observations: No significant variations were observed in rectal temperature and heart rate during the entire period of observation in any group. The heart rate increased non significantly after 5 min of ketamine administration and returned to the level of the base value and maintained that level throughout the period of observation (Table 1). Four animals of group II showed apnea after ketamine administration and the same existed for a period of 21.3 min (average).

Bradycardia was reported after administration of xylazine in calves (Campbell *et al.,* 1979). However, no effect on heart rate was observed by Sharma *et al.* (1983) in cattle after administration of xylazine (0.1 mg/kg)–ketamine anaesthesia either by i.m. (5 mg/kg) or i.v. (2 mg/kg) route. Significant decrease in heart and respiratory rates but no change in rectal temperature was observed in buffalo calves after xylazine-pentazocine administration (Doiphode and Aher, 2003).

Increase in heart rate after ketamine administration may be due to its cardiovascular stimulant property, which is due to action on sympathetic trunk and inhibition of neuronal uptake of catecholamine by sympathetic nerve endings (Ivankovitch *et al.,* 1974) or may be due to increase in central release of catecholamine resulting in tachycardia (Hardie and Lukasik, 2007). Kaushik (2001) observed no significant variation in heart rate and rectal temperature during peri-operative period after dipyrone injection in dogs pre-medicated with atropine; only respiratory rate decreased significantly during the surgery period.

Haematological Observations: In group I, non significant progressive decrease was observed in Hb, total erythrocyte count (TEC), total leukocyte count (TLC) and PCV from the base values till complete recovery. In groups II and III, no significant variation was observed in haematological parameters (Table 2).

Non significant reduction in Hb, PCV, TEC and TLC was observed after pentazocine–xylazine neuroleptanalgesia in buffalo calves (Doiphode and Aher, 2003) and also after xylazine administration in cattle (Kumar and Singh, 1979; Peshin and Kumar, 1979). No significant variation in haematological parameters were noted in camels after pentazocine-chlorpromazine combination (Singh *et al.,* 1994) and similar findings were observed in dogs and buffalo calves after pentazocine administration (Kumar *et al.,* 2002; Singh *et al.,* 2003). Kaushik (2001) also observed no significant variation in Hb, TLC and DLC during peri-operative period after dipyrone injection in dogs premedicated with atropine. The reduction in Hb, PCV and TEC may be attributed to sequestration of erythrocytes into spleen and extravascular compartment or haemodilution caused by water shift (Kandpal and Kumar, 1998). Decrease in TLC may be due to adrenocortical stimulation and subsequent effects of glucocorticoids on circulating neutrophils and lymphocytes.

Blood Biochemical Observations: Plasma glucose level showed progressive non-significant increase after 15 min of analgesic administration in all the three groups, however, glucose value returned near base values after 24 h. Significant increase in plasma glucose was observed in dogs after atropine-pentazocine-propofol injection (Chandrashekarappa and Ananda, 2009). Ninu (2009) observed non significant increase in plasma glucose level after glycopyrrolate-acepromazine-xylazine-ketamine combination in buffaloes till complete recovery from effects. Significant increase in blood glucose level was reported at peak of anaesthesia of xylazine-pentazocine in buffalo calves (Doiphode and Aher, 2003). Xylazine may directly stimulate hepatic glucose production *via* alpha adrenoceptors in liver (Tranquilli *et al.,* 1984). Moreover, during the period of anaesthesia, there is a decrease in basal metabolic rate of the animal and muscular activity is negligible, so utilization of glucose by muscles is also decreased probably causing slight increase in glucose concentration. Since hyperglycaemia produced is transient in nature, a clinical significance cannot be attached. A significant

Table 1
Different clinical parameters in various groups at different time intervals (Mean±S.E.)

Parameters (units)	Group I (GXPK)				Group II (GXBK)				Group III (GXDK)			
	Ambient temp. (^{0}C)	Rectal temp. (^{0}C)	Respiratory rate (breaths/min)	Heart rate (beats / min)	Ambient temp. (^{0}C)	Rectal temp. (^{0}C)	Respiratory rate (breaths/min)	Heart rate (beats / min)	Ambient temp. (^{0}C)	Rectal temp. (^{0}C)	Respiratory rate (breaths/min)	Heart rate (beats / min)
Before glycopyrrolate administration	33.5± 0.5[a]	38.5± 0.29[a]	16.80± 2.43[a]	53±4[a]	32.50± 0.22[a]	38.36± 0.16[a]	18.72± 3.10[a]	51.50± 3.53[a]	32.50± 0.22[a]	33.53± 2.34[a]	18.72± 3.10[a]	51.50± 3.53[a]
15 min after analgesic administration	34.02± 0.21[a]	38.06± 0.57[a]	16± 12.31[a]	50±4[a]	32.67± 021[a]	38.31± 0.24[a]	17.24± 3.24[a]	47.67± 2.80[a]	32.67± 021[a]	29.33± 2.43[a]	17.24± 3.24[a]	47.67± 2.80[a]
5 min after ketamine administration	33.47± 0.42[a]	38.76± 0.42[a]	13.83± 3.01[a]	55±4[a]	33.17± 0.30[a]	38.33± 0.26[a]	15.40± 3.28[a]	52.30± 3.27[a]	33.17± 0.30[a]	32.43± 3.02[a]	15.40± 3.28[a]	52.30± 3.27[a]
At recovery	33.57± 0.45[a]	39.23± 0.27[a]	17± 2.12[a]	55±3[a]	33.33± 0.33[a]	38.55± 0.26[a]	17.64± 3.48[a]	51.33± 2.81[a]	33.33± 0.33[a]	33.53± 2.34[a]	17.64± 3.48[a]	51.33± 2.81[a]
24 h after recovery	34.11± 0.21[a]	37.71± 0.19[a]	16.64± 1.76[a]	53±3[a]	31.67± 0.21[a]	38.40 .27[a]	17.82± 3.20[a]	53.67± 3.07[a]	31.67± 0.21[a]	33.6± 2.03[a]	17.82± 3.20[a]	53.67± 3.07[a]

Means with different superscripts in a row vary significantly (P<0.05)

Table 2
Different haemetological parameters in various groups at different time intervals (Mean±S.E.)

Parameters (units)	Group I (GXPK)					Group II (GXBK)					Group III (GXDK)				
	Before glycopyrrolate administration	15 min after pentazocine	5 min after ketamine	At recovery	24 h after recovery	Before glycopyrrolate adm-inistration	15 min after butorphanol	5 min after ketamine	At recovery	24 h after recovery	Before glycopyrrolate administration	15 min after dipyrone	5 min after ketamine	At recovery	24 h after recovery
Hb (g/dl)	11.56± 0.93[a]	10.93± 0.86[a]	10.2± 0.82[a]	9.8± 0.89[a]	10.90± 1.05[a]	11.10± 0.90[a]	10.30± 0.85[a]	9.66± 0.76[a]	10.16± 0.87[a]	9.43± 0.80[a]	10.70± 0.41[a]	10.35± 0.39[a]	10.00± 0.43[a]	9.76± 0.35[a]	10.23± 0.46[a]
PCV (%)	33.53± 2.34[a]	33.6± 2.03[a]	30.56± 2.46[a]	29.33± 2.43[a]	32.43± 3.02[a]	33.23± 2.92[a]	30.63± 2.55[a]	28.83± 2.03[a]	27.53± 2.25[a]	29.96± 2.60[a]	32.93± 1.51[a]	31.73± 1.12[a]	30.83± 1.10[a]	29.38± 1.20[a]	30.18± 1.28[a]
TLC (thousand/ cubic mm)	10971.67± 879.33[a]	10416.67± 774.45[a]	9991.67± 811.12[a]	9683.33± 777.60[a]	10500± 777.5[a]	9491.67± 830.74[a]	8966.67± 767.86[a]	8558.83± 661.86[a]	8300± 624[a]	8483.33± 674.47[a]	10880± 658.3[a]	10588± 647.82[a]	10240± 640.3[9a]	9906± 583[a]	10090± 598.67[a]
TEC (millions/ cubic mm)	7.87± 0.57[a]	7.58± 0.52[a]	7.20± 0.59[a]	7.03± 0.66[a]	7.40± 0.55[a]	7.53± 0.40[a]	7.06± 0.31[a]	6.66± 0.35[a]	6.51± 0.34[a]	6.89± 0.30[a]	7.66± 0.29[a]	7.52± 0.27[a]	7.18± 0.28[a]	7.11± 0.27[a]	7.46± 0.29[a]

Means with different superscripts in a row vary significantly (P<0.05)

Table 3
Different biochemical parameters in various groups at different time intervals (Mean±S.E.)

Parameters (units)	Group I (GXPK)					Group II (GXBK)					Group III (GXDK)				
	Before drug administration	15 min after pentazocine	5 min after ketamine	At recovery	24 h after recovery	Before drug administration	15 min after butorphanol	5 min after ketamine	At recovery	24 h after recovery	Before drug administration	15 min after dipyrone	5 min after ketamine	At recovery	24 h after recovery
Blood glucose	84.26±	93.98±	100.18±	94.82±	89.19±	83.69±	85.50±	105.80±	110.60±	84.12±	80.37±	90.82±	96.37±	89.74±	84.14±
(mg/dl)	9.84[a]	8.08[a]	8.75[a]	10.39[a]	6.96[a]	8.73[a]	9.45[a]	10.24[a]	11.32[a]	8.50[a]	8.53[a]	8.97[a]	8.15[a]	8.13[a]	8.80[a]
Cholesterol	66.81±	67.49±	69.19±	71.53±	68.53±	41.38±	43.52±	36.98±	35.65±	35.01±	58.33±	63.97±	70.04±	70.85±	67.38±
(mg/dl)	3.65[a]	2.57[a]	0.61[a]	1.34[a]	1.53[a]	5.40[a]	3.76[a]	4.28[a]	4.72[a]	2.91[a]	3.93[a]	4.19[a]	4.52[a]	4.08[a]	4.80[a]
Total protein	9.96±	10.31±	10.46±	10.50±	10.09±	6.92±	8.0±	7.53±	7.16±	6.81±	9.45±	9.54±	9.30±	9.35±	9.34±
(g/dl)	0.40[a]	0.44[a]	0.48[a]	0.45[a]	0.44[a]	0.50[a]	0.54[a]	0.72[a]	0.52[a]	0.39[a]	0.23[a]	0.24[a]	0.5[a]	0.25[a]	0.23[a]
Albumin	5.14±	5.44±	5.52±	5.50±	5.38±	3.81±	4.16±	3.72±	3.67±	3.77±	5.07±	5.04±	4.96±	4.96±	4.98±
(g/dl)	0.16[a]	0.22[a]	0.27[a]	0.23[a]	0.23[a]	0.29[a]	0.35[a]	0.38[a]	0.21[a]	0.22[a]	0.14[a]	0.15[a]	0.14[a]	0.13[a]	0.15[a]
Bilirubin	0.24±	0.24±	0.24±	0.22±	0.25±	0.22±	0.25±	0.26±	0.27±	0.21±	0.17±	0.17±	0.18±	0.18±	0.17±
(mg/dl)	0.02[a]	0.16[a]	0.16[a]	0.25[a]	0.18[a]	0.03[a]	0.04[a]	0.05[a]	0.03[a]	0.03[a]	0.01[a]	0.01[a]	0.01[a]	0.01[a]	0.01[a]
ALT	37.47±	43.18±	43.52±	42.82±	40.46±	31.70±	36.03±	39.09±	40.20±	32.71±	39.0±	45.21±	48.81±	45.90±	43.93±
(U/L)	2.71[a]	3.38[a]	3.59[a]	2.88[a]	2.41[a]	1.89[a]	0.62[a]	2.70[a]	2.98[a]	3.66[a]	2.91[a]	2.66[a]	3.60[a]	3.52[a]	3.62[a]
AST	179.04	200.11	204.03	192.25	184.99	242.63	259.91	232.57	260.73	246.81	183.10	189.94	197.13	189.51	191.20
(U/L)	±9.91[a]	±9.63[a]	±10.90[a]	±5.17[a]	±8.85[a]	±12.2[a]	±11.13[a]	±9.06[a]	±9.38[a]	±13.5[a]	±4.66[a]	±4.25[a]	±3.87[a]	±4.70[a]	±4.55[a]
ALKP	173.91	179.00±	184.00±	183.59±	177.55±	128.25	129.41±	115.55±	127.05±	120.06±	200.76±	215.0±	222.44±	200.46	205.70
(U/L)	±11.13[a]	13.45[a]	13.60[a]	11.23[a]	10.73[a]	±8.57[a]	10.90[a]	10.93[a]	14.22[a]	5.20[a]	14.21[a]	15.20[a]	15.3[9a]	±12.71[a]	±15.35[a]
Sodium	147.23	148.02	148.60	147.37	147.86	150.18	149.60	150.52	150.04	150.25	141.50	136.45	135.0	140.66	136.29
(mmol/l)	±2.23[a]	±2.21[a]	±2.57[a]	±2.37[a]	±1.73[a]	±2.0[a]	±1.8[a]	±2.87[a]	±2.27[a]	±2.42[a]	±2.10[a]	±2.20[a]	±3.30[a]	±3.30[a]	±2.20[a]
Potassium	3.99±	3.89±	4.15±	4.04±	4.09±±	3.53	3.85±	3.50±	3.44±	3.87±	3.80±	3.84±	3.92±	3.83±	3.73±
(mmol/l)	0.17[a]	0.15[a]	0.22[a]	0.16[a]	0.18[a]	±0.45[a]	0.35[a]	0.37[a]	0.23[a]	0.14[a]	0.19[a]	0.21[a]	0.19[a]	0.21[a]	0.18[a]
Chloride	90.69±	100.86	105.16	99.19±	95.79±	95.50	103.88	110.74	106.28	109.06	101.23	103.88	106.30	103.82	102.27
(mmol/L)	3.88[a]	±1.30[b]	±1.99[b]	4.48[ab]	2.52[ab]	±5.92[a]	±3.02[a]	±3.90[a]	±7.88[a]	±3.66[a]	±2.85[a]	±2.25[a]	±2.06[a]	±2.88[a]	±2.21[a]
BUN	27.99±	28.11±	28.42±	28.63±	29.86±	21.12	21.19±	21.26±	20.77±	21.06±	29.82±	31.26±	32.44±	31.39	29.33±
(mg/dl)	1.08[a]	1.28[a]	1.15[a]	1.40[a]	1.40[a]	±0.40[a]	0.40[a]	0.44[a]	0.45[a]	0.36[a]	2.48[a]	2.38[a]	2.72[a]	±2.16[a]	1.98[a]
Creatnine	2.12±	2.18±	2.23±	2.18±	2.15±	2.19±	2.34±	2.38±	2.23±	2.18±	3.07±	3.11±	3.14±	3.01±	3.08±
(mg/dl)	0.12[a]	0.13[a]	0.13[a]	0.13[a]	0.13[a]	0.16[a]	0.18[a]	0.22[a]	0.12[a]	0.16[a]	0.10[a]	0.10[a]	0.11[a]	0.11[a]	0.12[a]
Calcium	3.21±	3.34±	3.28±	3.29±	3.36±	9.09±	9.55±	10.56±	9.50±	9.25±	6.07±	6.22±	6.17±	6.23±	6.28±
(mg/dl)	0.10[a]	0.11[a]	0.09[a]	0.12[a]	0.10[a]	0.88[a]	1.02[a]	0.80[a]	0.60[a]	0.58[a]	0.44[a]	0.48[a]	0.46[a]	0.43[a]	0.45[a]
Phosphorus	3.34±	3.28±	3.29±	3.36±	3.29±	3.56±	3.53±	3.63±	3.57±	3.65±	2.98±	3.10±	2.98±	2.90±	2.94±
(mg/dl)	0.11[a]	0.09[a]	0.12[a]	0.10[a]	0.07[a]	0.05[a]	0.05[a]	0.08[a]	0.06[a]	0.05[a]	0.28[a]	0.25[a]	0.28[a]	0.26[a]	0.27[a]
Magnesium	4.39±	4.47±	4.53±	4.47±	4.47±	4.73±	4.63±	4.70±	4.87±	4.11±	4.58±	4.75±	4.51±	4.45±	4.61±
(mg/dl)	0.17[a]	0.17[a]	0.16[a]	0.18[a]	0.16[a]	0.28[a]	0.36[a]	0.27[a]	0.23[a]	0.41[a]	0.22[a]	0.24[a]	0.22[a]	0.22[a]	0.14[a]

Means with different superscripts in a row vary significantly (P<0.05)

increase in plasma chloride was observed after 15 min of pentazocine administration and five min after ketamine administration. The values remained elevated at recovery in comparison to the base value and non significant progressive increase in total plasma protein was observed after 15 min of pentazocine administration, 5 min after ketamine and till the complete recovery in group I (Table 3). Ninu (2009) observed non significant variation in plasma chloride level after glycopyrrolate-acepromazine-xylazine-ketamine combination in buffaloes. Hyperchloraemia may be the result of change in relative water content of body or may be associated with compensated respiratory alkalosis as well as metabolic acidosis (Carlson, 1989). In group II, plasma albumin showed a non significant increase after butorphanol administration and non significant decrease at recovery in comparison to the base value (Table 3). Kaushik (2001) observed non significant hyperglycemia during post-operative period after dipyrone (Analgin) injection in dog pre medicated with atropine. Non significant variations in BUN, creatinine, Ca, P, Mg, potassium, bilirubin and cholesterol within group and in between groups were observed in this study. No significant variations were reported in plasma glucose, total proteins, creatinine and cholesterol values after pentazocine-diazepam combination in buffalo calves (Kumar *et al.*, 2002).

On the basis of results of clinico-haemato-biochemical parameters, it was concluded that pentazocine lactate was a safe analgesic followed by dipyrone and butorphanol tartrate in combination with glycopyrrolate–xylazine–ketamine for use in buffaloes undergoing diaphragmatic herniorrhaphy.

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