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Research Article

EVALUATION OF PROPOFOL AS AN ANAESTHETIC IN BUFFALO CALVES (BUBALUS BUBALIS)

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ABSTRACT

Twelve clinically healthy young buffaloes of 1 to 2 years weighing 80-140 kg divided randomly into two groups of six animals each were taken to evaluate propofol (4.0 mg/kg intravenously) as an anaesthetic agent. Animals became ataxic immediately after propofol administration and fell down in 25±3 seconds (16 to 36 seconds). There was appreciable cutaneous analgesia but no analgesia was observed on scratching of rib periosteum. Apnoea was observed in all the young buffaloes in 75±8 seconds (55 second to 2 minutes) and respiration was regained at 145±21 seconds (120 to 180 seconds). Mild salivation and lacrimation were also observed in all the animals. Animals recovered completely from the effects of propofol by 39±3 minutes (34 to 50 minutes). Respiration rate increased significantly at peak effect of propofol. There was no major variation in rectal temperature, haematological and plasma biochemical parameters except sodium and potassium, which were significantly higher after propofol administration. There was a significant increase in heart rate after propofol administration. A statistically significant increase was seen in mean arterial pressure at 5 and 10 minutes whereas central venous pressure was significantly lower when compared to base values.

Key words: Propofol, buffalo calves

Propofol is highly lipophilic drug derived from the series of alkyl phenol, which is unique class of anaesthetic agents (James and Glen, 1980). Propofol is an intravenous general anaesthetic agent, which has rapid onset, prompt and smooth recovery without cumulative effect even after its prolonged administration (Morgan and Legge, 1989; Short and Bufalari, 1999). In the recent years, its use has become increasingly popular both in animals as well as human beings for undertaking major and minor surgical procedures. The present study was undertaken with the objective to evaluate the efficacy of propofol as an anaesthetic in young water buffaloes.

MATERIALS AND METHODS

Twelve apparently healthy young water buffaloes of 1 to 2 years of age weighing 80-140 kg were divided randomly into two groups of six animals each. Pilot trials were conducted using varying doses of propofol [Propofol injection (2, 6-di-isopropylphenol), Neon Laboratories Ltd., Andheri (East), Mumbai] i.e. 4.0 to 8.0 mg per kg intravenously to achieve desired central nervous system (CNS) depression, the induction of anaesthesia, sufficient relaxation of jaw and abolition of the swallowing reflex. The desired results were achieved at the dose rate of 4.0 mg/kg. In group I, the parameters recorded were: behavioral changes as and when occurred (weak time, down time, relaxation of muscles, ear flapping, efficacy of tracheal intubation, panniculus reflex and periosteal scratch reflex whereas signs of recovery included: head rightening, return of panniculus reflexes, spontaneous standing time, munching and complete recovery time), rectal temperature, heart and respiration rates, haemoglobin, packed cell volume, erythrocyte sedimentation rate, blood/plasma glucose, cholesterol, urea nitrogen, creatinine, total plasma proteins, albumin, calcium, inorganic phosphorus, magnesium, sodium, potassium, chloride, alanine transaminase (ALT), aspartate transaminase (AST), alkaline phosphatase (ALKP) and bilirubin were studied before and at 5 minutes of propofol administration, at recovery and 24 hours after the administration of propofol. In group II, blood pressure, MAP (mean arterial pressure), central venous pressure (CVP) and electrocardiogram (ECG) were recorded before and at 2, 5, 10, 15, 20, 25 and 30 minutes after the administration of propofol. The statistical analysis of data was done by one-way-analysis of variance and Duncan's multiple range test (Duncan, 1955).

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RESULTS AND DISCUSSION

Different physiological, hematological and biochemical parameters are presented in Tables 1 to 3. In group I, animals became ataxic immediately after propofol administration and fell down in 25±3 seconds (16 to 36 seconds). Swallowing reflex, palpabral reflex and panniculus reflex were abolished in 180±26 seconds, 214±9 seconds and 268±27 seconds, respectively. In addition, there was relaxation of muscles in 217±16 seconds. Sleepy look was observed at 38±3 seconds (24 to 40 seconds). Pain sensation was abolished in 248±27 seconds (120 to 360 seconds). There was appreciable cutaneous analgesia as determined by pin pricks at abdominal skin, fetlock and interdigital space, but no analgesia was observed on scratching of rib periosteum.

Apnoea was observed in all the animals at 75±8 seconds (55 to 120 seconds) and respiration was regained at a mean time of 145±21 seconds (120 to 180 seconds). Apnoea during propofol administration has also been reported in dogs (David, 1993; Smith *et al.,* 1993; Hall and Peshin, 1996), horses (Matthews *et al.,* 1999) and wild turkeys (Schumacher *et al.,* 1997). A transient apnoea of about 2 minutes has been reported immediately after administration of thiopentone in buffalo calves premedicated with atropine and diazepam (Singh *et al.,* 2006). Apnoea may occur due to sympatho-adrenal response to hypercapnia and hypotension. Ear flapping was observed in all the animals at a mean time of 350±6 seconds (180 to 720 seconds). It may be because of moderate anaesthesia.

The palpaberal reflex was abolished in 204±9 seconds (180 to 240 seconds). Salivation was observed in all the young buffalo calves at 151±11 seconds (120 to 240 seconds) and lacrimation in 255±26 seconds (120 to 360 seconds). Swallowing reflex was abolished at 180±26 seconds (60 to 240 seconds).

Analgesia disappeared in 1076±32 seconds (960 to 1200 seconds) after propofol administration. Swallowing reflex was regained in 1163±135 seconds (16 to 26 minutes). The animals started nibbling of grass (browsing time) at 1307±144 seconds (1080 to 1800 seconds) and head rightening reflex returned at 1566±240 seconds (1500 to 2820 seconds). Animals stood up at 2098±182 seconds (1200 to 2400 seconds) of propofol administration. Animals completely recovered from the effects of propofol by 2361±184 seconds (2040 to 3000 seconds). The quick distribution and metabolism of the drug also explains the rapid, smooth recovery from propofol anaesthesia (Langley and Keel, 1988). Propofol is also rapidly cleared by hepatic and perhaps extra hepatic metabolism (Kanto and Gepts, 1989). The total body clearance of propofol is quick and exceeds hepatic blood flow, suggesting extra hepatic metabolism (Adam *et al.,* 1983).

Physiological parameters such as body temperature and respiration rate are bench markers of indispensable monitoring protocol. Respiration rate increased significantly at peak effect of propofol (30±3 breaths per minute) as compared to base value (16±2 breaths per minute). There was no major variation in rectal temperature after propofol administration (Table 1). However, rectal temperature decreased non-significantly after propofol administration in goats (Sahay and Dass, 2005). There was no significant change in any of the haematological and plasma biochemical parameters after the administration of propofol except

Table 1

Effects of intravenous administration of propofol on physiological and haematological parameters in young buffalo calves

Parameters	Before administration of drug	At its peak effect	At recovery	24 hours after injection
Ambient temperature (°C)	27.00^{a}±0.258	27.16^{a}±0.307	27.16^{a}±0.307	26.66^{a}±0.210
Rectal temperature (°C)	37.68^{a}±0.213	37.43^{a}±0.180	37.43^{a}±0.204	37.68^{a}±0.213
Respiration rate/min	16^{b}±2	30^{a}±3	22^{b}±1	18^{b}±2
Haemoglobin (g/dl)	11.80^{a}±0.420	11.93^{a}±0.440	11.88^{a}±0.436	11.85^{a}±0.389
ESR (mm first hour)	46^{a}±5.637	41^{a}±4.300	45^{a}±5.413	34^{a}±4.828
Packed cell volume (%)	38^{a}±3.702	42^{a}±3.293	38^{a}±3.609	38^{a}±3.783

All values are mean±S.E. of six animals; Mean with different superscripts within a row vary significantly ($p<0.05$)

Table 2

Effects of intravenous administration of propofol on biochemical parameters in young buffalo calves

Parameters	Before administration of drug	At its peak effect	At recovery	24 hours after injection
Plasma glucose (mmol/L)	2.7^{ab}±0.2	3.8^{a}±0.6	3.4^{ab}±0.5	2.4^{b}±0.1
Cholesterol (mmol/L)	2.4^{a}±0.1	2.4^{a}±0.1	2.4^{a}±0.1	2.4^{a}±0.1
BUN (mmol/L)	6.1^{a}±0.5	5.7^{a}±0.7	6.0^{a}±0.6	5.9^{a}±0.7
Creatinine (µmol/L)	1.5^{a}±0.1	1.5^{a}±0.1	1.6^{a}±0.1	1.5^{a}±0.1
Total proteins (g/L)	88^{a}±2.4	90^{a}±2.3	86^{a}±1.7	84^{a}±2.8
Albumin (g/L)	48^{a}±1.1	48^{a}±1.5	49^{a}±1.5	47^{a}±1.5
Globulin (g/L)	40^{a}±5.2	42^{a}±2.5	37^{a}±2.9	37^{a}±3.3
Albumin:Globulin ratio	12^{a}±0.9	13^{a}±1.2	12^{a}±1.8	12^{a}±1.3
Calcium (mmol/L)	2.2^{a}±0.1	2.2^{a}±0.0	2.3^{a}±0.1	2.2^{a}±0.0
Phosphorus (mmol/L)	1.9^{a}±0.1	1.9^{a}±0.1	2.0^{a}±0.1	2.0^{a}±0.1
Magnesium (mmol/L)	0.9^{a}±0.0	0.9^{a}±0.0	0.9^{a}±0.0	0.9^{a}±0.0
Sodium (mmol/L)	124^{c}±9.73	159^{a}±4.65	139^{b}±4.25	115^{c}±6.57
Potassium (mmol/L)	3.5^{c}±0.02	6.6^{a}±0.35	3.9^{b}±0.30	3.8^{c}±0.14
Chloride (mmol/L)	85^{a}±3.61	76^{a}±2.72	79^{a}±3.67	84^{a}±3.59
Bilirubin (µmol/L)	3.8^{a}±0.3	3.6^{a}±0.3	3.2^{a}±0.2	3.1^{a}±0.3
SGOT/AST (U/l)	161^{a}±4.47	157^{a}±4.76	168^{a}±8.16	168^{a}±4.99
SGPT/ALT (U/l)	35^{a}±1.88	30^{a}±2.63	33^{a}±2.13	32^{a}±3.19
ALKP (U/l)	73^{a}±8.24	75^{a}±8.74	72^{a}±6.51	74^{a}±5.04

All values are mean±S.E. of six animals; Mean with different superscripts (a, b, c) within a row vary significantly ($p<0.05$); BUN=blood urea nitrogen; AST=aspartate transaminase; ALT=alanine transaminase; ALKP=alkaline phosphatase

for sodium and potassium, which were significantly higher after propofol administration and remained higher till recovery compared to base values. Significant changes in sodium concentration before, during and after anaesthesia have been observed in calves (Genccelep *et al.,* 2005) when propofol was used for induction and maintenance of anaesthesia. Sodium, potassium and chloride ions maintain the resting membrane potential and are very important for existence of cells.

Plasma glucose was also elevated after propofol administration which is probably the sign of stress. In the present study, the stress was also brief that is why the levels were not altered significantly. An increase in blood glucose concentration, in the absence of any other blood biochemical changes has been reported after propofol administration in dogs (David, 1993). In group II, there was an increase in heart rate after propofol administration. However, changes observed in the heart rate at 5 minutes, at 10 minutes and at 15 minutes of propofol administration were significant than base value. Similar findings have been observed in dogs (Weaver and Raptopoulos, 1990; Cullen and Reynoldson, 1993), calves (Genccelep *et al.,* 2005), goats (Sahay and Dass, 2005), and horses (Mama and Steffey, 1996). A significant increase in MAP was seen at 5 and 10 minutes when compared to base value. However, the CVP was significantly lower at 15, 20 and 25 minutes

Table 3

Effects of intravenous administration of propofol on heart rate, mean arterial pressure and central venous pressure in young buffalo calves

Parameter (units)	Base value	After propofol administration						
		2 min	5 min	10 min	15 min	20 min	25 min	30 min
Heart rate/min	52^{c}±5.285	59^{bc}±4.374	82^{a}±4.978	87^{a}±7.827	68^{b}±2.551	56^{bc}±2.250	56^{bc}±3.229	53^{c}±3.844
MAP	19.5^{b}±0.783	18.1^{b}±0.718	22.9^{a}±1.080	22.9^{a}±1.061	20.8^{ab}±1.077	20.1^{ab}±1.072	19.6^{b}±1.116	19.4^{b}±0.783
CVP (kPa)	1.41^{a}±0.135	1.16^{ab}±0.075	1.13^{ab}±0.122	1.13^{ab}±0.137	0.99^{b}±0.129	0.91^{b}±0.097	0.98^{b}±0.148	1.04^{ab}±0.129

All values are mean±S.E. of six animals; Mean with different superscripts (a,b,c) within a row vary significantly ($p<0.05$)

when compared to base value. It is clear that propofol does not depress the control on sympathetic limb of autonomic nervous system. That is why heart rate and MAP respond without change in peripheral vascular resistance. Certainly the hypotension exhibited is not because of decrease in peripheral vascular resistance, there was systemic vasodilatation (Glen, 1980).

The ECG changes in the buffalo calves of the present study were not consistent. T-wave became biphasic after administration of propofol in two animals and there was third degree AV-dissociation in four animals. Therefore, unless more information is available concerning the effects of halothane on buffalo heart, caution should be used in administrating propofol to an animal with heart ailments.

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