



ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; SP-12(9): 14-18
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www.thepharmajournal.com
Received: 20-07-2023
Accepted: 29-08-2023

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Comparison of the effects of thiopentone and propofol on blood gas analysis in dogs

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Abstract

The study was conducted on 12 clinical cases of dogs which were randomly assigned to one of the two induction agents thiopentone and propofol. All the dogs, were premedicated with cocktail of glycopyrrolate, butorphanol and midazolam, intramuscularly. Induction using 2.5% thiopental @ 10 mg/kg body weight and propofol (10 mg/ml) @ 4 mg/kg body weight, intravenously in animals of group A and B, respectively, and maintenance with isoflurane in both the groups. The mean value of pH showed a decreasing trend upto the peak anaesthesia level following administration of induction agent in both the groups. Mean PaO₂ values showed a rising trend immediately after induction in both the groups.

Keywords: Glycopyrrolate, midazolam, butorphanol, thiopental, propofol, dog

Introduction

Propofol and Thiopentone are the two induction agents most commonly used in veterinary anaesthesia. propofol is an alkyl phenol and Thiopentone is an ultra-short-acting thiobarbiturate, but they have similar anaesthetic properties Dennis *et al.*, (2007) ^[1]. Blood gas analysis is useful to assess respiratory ventilation, oxygenation, and acid-base balance, thus accessing the physiological state of the patient Wagner (2015) ^[10]. To our knowledge, the arterial blood gas analysis changes in dogs using propofol and Thiopentone as induction agents in the dog have not been reported. The purpose of this study was to estimate the effects of thiopentone and propofol on the blood gas analysis in dogs with musculoskeletal affections.

Materials and Methods

The present study was conducted on 12 dogs presented with musculoskeletal affections to Teaching Veterinary Clinical Complex of DUVASU, Mathura. The animals were randomly divided in to two groups of 6 animals each- group A and group B. In both the groups, a mixture of glycopyrrolate (0.01 mg/kg), butorphanol (0.2 mg/kg) and midazolam (0.2 mg/kg) was administered, intramuscularly as preanaesthetic agent. After 10 minutes of premedication, general anaesthesia was induced in both the groups with two different protocols. In group-A the animals were induced with 2.5% thiopental @ 10 mg/kg and in animals of group-B with propofol (10 mg/ml) @ 4mg/kg, intravenously, to effect and maintained with isoflurane (1.5-2%) in 100% oxygen for both the groups.

Blood gas parameters (pH, PaCO₂, PaO₂ and HCO₃⁻) were recorded at before pre-anaesthetics (PA), after induction (AI), at peak effect (PE) and at recovery (AR).

Blood samples (Arterial & venous) were collected before pre-anaesthetics (PA), after induction (AI), at peak effect (PE) and at recovery (AR) using femoral/dorsal pedal artery for arterial blood and cephalic, saphenous for venous blood gas parameters analysis.

Results

Blood gas variations

Blood gas parameters (Arterial and Venous) were recorded as before pre-anaesthetic administration (PA), after induction (AI), at peak effect of anaesthesia (AP) and after recovery (AR) in both the groups.

Arterial blood gas variations

pH

Mean pH value at AI, PE and AR showed a decrease in both the groups in comparison to its base value at PA, however, as the graph shows, in group-A, rising trend started occurring after

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PE than in group-B. Between the groups, the mean values differ non-significantly ($p \geq 0.05$) except at peak anaesthesia

level. The group and interval wise mean pH and its graphic representation is given in table-1.

Table & Fig 1: Mean \pm S.D of pH in dogs anaesthetized with Thiopental and Isoflurane (Group-A; n=6); Propofol and Isoflurane (Group-B; n=6)

Gr.	PA	AI	PE	AR
A	7.27 \pm 0.02	7.25 \pm 0.04	7.14 \pm 0.05	7.21 \pm 0.06
B	7.29 \pm 0.04	7.27 \pm 0.03	7.24 \pm 0.03	7.21 \pm 0.01
P	$p \geq 0.05$		$p < 0.05$	$p \geq 0.05$

Partial pressure of carbon dioxide (PaCO₂)

Mean partial pressure of carbon dioxide at AI, PE, showed an increase in group-A. In group-B, it showed a decrease at AI, then increase upto PE. However, beyond PE the mean value showed increase at AR in both the groups indicating a rising

trend. Between the groups, the mean values at various intervals did not differ significantly ($p \geq 0.05$). The group and interval wise mean partial pressure of carbon dioxide and its graphical representation is given in table-2.

Table & Fig 2: Mean \pm S.D of Partial pressure of carbon dioxide (mmHg) in dogs anaesthetized with Thiopental and Isoflurane (Group-A; n=6); Propofol and Isoflurane (Group-B; n=6)

Gr.	PA	AI	PE	AR
A	45.63 \pm 2.83	55.47 \pm 6.25	50.38 \pm 1.50	54.28 \pm 1.95
B	46.71 \pm 7.59	39.13 \pm 6.86	49.54 \pm 3.64	54.88 \pm 3.98
P	$p \geq 0.05$			

Partial pressure of oxygen (PaO₂)

Mean partial pressure of oxygen at AI, PE showed an increase in both the groups in comparison to its base value at PA, however, beyond PE, its showed a declining trend and at AR its mean value was more than the mean value at PA in

respective groups. Between the groups, the mean values at various intervals did not differ significantly ($p \geq 0.05$). The group and interval wise mean partial pressure of oxygen and its graphical representation is given in table-3.

Table & Fig 3: Mean \pm S.D of Partial pressure of oxygen (mmHg) in dogs anaesthetized with Thiopental and Isoflurane (Group-A; n=6); Propofol and Isoflurane (Group-B; n=6)

Gr.	PA	AI	PE	AR
A	102.14 \pm 3.39	259.67 \pm 8.53	291.61 \pm 9.27	132.19 \pm 9.57
B	101.52 \pm 10.66	217 \pm 83.13	251.64 \pm 90.39	136.74 \pm 5.35
P	$p \geq 0.05$			

Bicarbonate (HCO₃⁻)

Mean bicarbonate at AI, showed an increase then decreased at PE in both the groups. In group B, it gradually decreased upto PE. However, beyond PE the mean value showed increase at AR in both the groups indicating a rising trend. Between the

groups, the mean values at various intervals did not differ significantly ($p \geq 0.05$) except at AI, PE. The group and interval wise mean bicarbonate and its graphical representation is given in table-4.

Table & Fig 4: Mean \pm S.D of Bicarbonate (mEq/L) in dogs anaesthetized with Thiopental and Isoflurane (Group-A; n=6); Propofol and Isoflurane (Group-B; n=6)

Gr.	PA	AI	PE	AR
A	20.46 \pm 2.32	23.40 \pm 0.08	16.83 \pm 2.28	21.36 \pm 2.35
B	22.30 \pm 5.71	26.00 \pm 1.79	20.70 \pm 1.64	21.56 \pm 2.16
P	$p \geq 0.05$	$p < 0.05$		$p \geq 0.05$

Venous blood variations

pH

Mean pH value at AI, PE showed a gradual decrease in both the groups in comparison to its base value at PA, however, beyond PE, its showed a rising trend and at AR its mean value

was less than the mean value at PA in respective groups. Between the groups, the mean values differ non-significantly ($p \geq 0.05$) except at AR. The group and interval wise mean pH and its graphic representation is given in table-5.

Table & Fig 5: Mean \pm S.D of pH in dogs anaesthetized with Thiopental and Isoflurane (Group-A; n=6); Propofol and Isoflurane (Group-B; n=6)

Gr.	PA	AI	PE	AR
A	7.29 \pm 0.01	7.26 \pm 0.02	7.17 \pm 0.02	7.20 \pm 0.01
B	7.31 \pm 0.02	7.24 \pm 0.04	7.12 \pm 0.06	7.26 \pm 0.02
P		$p \geq 0.05$		$p < 0.05$

Partial pressure of carbon dioxide (PaCO₂)

Mean partial pressure of carbon dioxide at AI, PE, showed an increase in both the groups. However, beyond PE the mean value showed increase at AR in group- A and decrease in group-B but the mean value at AR was more than the mean

value at base line in both the groups. Between the groups, the mean values at various intervals did not differ significantly ($p \geq 0.05$). The group and interval wise mean partial pressure of carbon dioxide and its graphical representation is given in table-6.

Table & Fig. 6: Mean \pm S.D of Partial pressure of carbon dioxide (mmHg) in dogs anaesthetized with Thiopental and Isoflurane (Group-A; n=6); Propofol and Isoflurane (Group-B; n=6)

Gr.	PA	AI	PE	AR
A	46.47 \pm 4.42	55.00 \pm 7.13	52.69 \pm 8.59	54.63 \pm 3.27
B	44.46 \pm 2.70	51.66 \pm 5.10	56.07 \pm 4.96	50.86 \pm 8.04
P	$p \geq 0.05$			

Partial pressure of oxygen (PaO₂)

Mean partial pressure of oxygen at AI, PE showed an increase in both the groups in comparison to its base value at PA, however, beyond PE, it showed a declining trend and at AR its mean value was more than the mean value at PA in

respective groups. Between the groups, the mean values at various intervals did not differ significantly ($p \geq 0.05$) except at AI and PE. The group and interval wise mean partial pressure of oxygen and its graphical representation is given in table-7.

Table & Fig 7: Mean \pm S.D of Partial pressure of oxygen (mmHg) in dogs anaesthetized with Thiopental and Isoflurane (Group-A; n=6); Propofol and Isoflurane (Group-B; n=6)

Gr.	PA	AI	PE	AR
A	86.49 \pm 5.45	116.31 \pm 32.61	165.43 \pm 15.86	101.89 \pm 11.71
B	79.17 \pm 7.15	166.13 \pm 8.66	199.15 \pm 11.01	102.46 \pm 6.39
P	$p \geq 0.05$	$p < 0.05$		$p \geq 0.05$

Bicarbonate (HCO₃⁻)

Mean bicarbonate at AI, showed an increase then decreased at PE in group-A and gradually decrease upto PE in group-B. However, beyond PE the mean value showed increase at AR in both the groups indicating a rising trend. Between the

groups, the mean values at various intervals did not differ significantly ($p \geq 0.05$). The group and interval wise mean bicarbonate and its graphical representation is given in table-8.

Table & Fig 8: Mean \pm S.D of Bicarbonate (mEq/L) in dogs anaesthetized with Thiopental and Isoflurane (Group-A; n=6); Propofol and Isoflurane (Group-B; n=6)

Gr.	PA	AI	PE	AR
A	21.7 \pm 2.90	23.93 \pm 3.53	18.8 \pm 2.64	20.93 \pm 0.85
B	22.03 \pm 2.26	21.83 \pm 4.56	17.8 \pm 2.38	22.34 \pm 4.12
P	$p \geq 0.05$			

Discussions

The mean value of pH showed a decreasing trend upto the peak anaesthesia level following administration of induction agent in both the groups. Similar findings were observed by Enouri *et al.* (2008) ^[2] with the decrease in pH after induction with thiopental and propofol and also by Fukushima *et al.* (2011) ^[3] who noted a decrease in blood pH at various time intervals after using propofol as an induction agent and isoflurane as a maintenance agent. On comparison between the groups, it showed a non-significant ($p \geq 0.05$) difference except at peak anaesthesia level and this was in accordance with the findings who also observed a non-significant ($p \geq 0.05$) difference in blood gas variables in dogs under propofol anaesthesia.

There was a variable trend noticed in mean value of PaCO₂ of both the groups. It showed an increase and a decrease after induction in thiopental and propofol group, respectively. Similar to this, a decrease in post induction mean values after propofol was observed by Kattan (2013) ^[6]. Contrary to this an increase in post induction PaCO₂ was found in case of propofol (Maney *et al.*, 2013; Sams *et al.*, 2008) ^[7, 9]. On comparison between the groups, the difference was non-significant. Similar findings were observed with the no significant difference in blood gas variables in propofol anaesthesia in dogs.

Mean PaO₂ values showed a rising trend immediately after induction in both the groups which was supported by the findings of Kattan (2013) ^[6]. However after administration of isoflurane, both the groups showed a greater increase in mean PaO₂ value compared to the base line values. Similar findings were reported by Enouri *et al.* (2008) ^[2] and Kattan (2013) ^[6], who observed an increase during administration of isoflurane anaesthetic agent. On comparison between the groups, the difference was non-significant ($p \geq 0.05$) which was in accordance with the findings of Hofmeister *et al.* (2008) ^[9].

The mean values of HCO₃ in both the groups showed an increase and decrease after induction and at peak level of anaesthesia, respectively. Similar findings of an increase in post induction mean values of HCO₃ in case of propofol anaesthesia in dogs was observed by Maney *et al.* (2013) ^[7] and Sams *et al.* (2008) ^[9]. However, Enouri *et al.* (2008) ^[2] observed a decrease in base excess after administration of isoflurane in thiopental and propofol induced anaesthesia in dogs. In the present work on comparison between the groups, it showed a significant ($p < 0.05$) difference at induction and at peak anaesthesia level which is contrary to the findings of Hofmeister *et al.* (2008) ^[9]. The reason of this could have been the difference in the base values in both the groups before administration of pre-anaesthetics (PA mean value).

Venous blood gas analysis was done to find an agreement with arterial blood gas mean values for the same parameters as venous blood sampling and vein access is relatively less challenging, safe and less time consuming procedure. Whereas, a similar trend of change in mean pH and PaO₂ was seen between ABG and VBG samples of the same interval, gross dissimilarity was there in mean PaCO₂ and HCO₃ values of ABG and VBG samples making this an unreliable method. In the perused literature, however, it is reported that the pH and PaCO₂ provide clinically acceptable substitute of ABG samples in the dog population study Pang *et al.* (2009) ^[8].

Conclusion

Thiopentone and propofol both cause insignificant changes in acid-base values, making them suitable induction agents for

dogs whose acid-base values have altered.

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