International Journal of Veterinary Sciences and Animal Husbandry

ISSN: 2456-2912
VET 2024; SP-9(2): 120-123

www.veterinarypaper.com
Received: 07-12-2023
Accepted: 10-01-2024

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Clinicophysiological and Haematobiochemical effects of propofol and tiletamine-zolazepam anaesthesia in dogs

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Abstract
The study evaluated the two different anaesthetic protocols in dogs for haemato-biochemical parameters and the clinico-physiological parameters *viz*., heart rate (beats/minute), respiratory rate (breaths/minute), rectal temperature (^{0}F), saturation of oxygen (SpO_2) and blood pressure. All the animals were first premedicated with butorphanol and xylazine at the same time. After 15 minutes of preanaesthetic medication, induction and maintenance of anaesthesia was achieved by administration of propofol in Group-I and tiletamine-zolazepam in Group-II. The Haemato-biochemical parameters and the clinico-physiological parameters were measured and evaluated for both groups. All clinico-physiological parameters were within normal limits. Propofol group shows more cardio-pulmonary depression as compared to tiletamine-zolazepam group.

Keywords: Butorphanol, xylazine, dog, propofol, tiletamine-zolazepam

Introduction
An essential component of surgical intervention is anaesthesia, which enables the surgeon to do the process with the greatest degree of accuracy (Muhammad *et al.*, 2009) [12]. Balanced anaesthesia provides good intraoperative cardiopulmonary functions, minimise the pain associated with surgery and provides calmer and smooth, coordinated recoveries (Bettschart-wolfensberger and Larenza 2007) [4]. In recent years, continuous total intravenous anaesthesia (TIVA) has gained popularity in veterinary anaesthesia. TIVA uses a combination of an α-2 agonist with opiods and anaesthetic agents like propofol, tiletamine-zolazepam which anaesthetize animal by the combination of central nervous system (CNS) depression, muscular relaxation and analgesia. The appropriate selection of pre-anaesthetic drugs can significantly contribute to perioperative analgesia, intraoperative cardiovascular stability and quality of recovery (Murrell, 2016) [14]. The present clinical study was undertaken to compare the clinico-physiological and haemato-biochemical parameters of propofol vs. tiletamine-zolazepam anaesthesia in various surgical cases in dogs.

Materials and Methods
The present clinical study was carried out during 2022-2023 at the Department of Veterinary Surgery Radiology, College of Veterinary Science and Animal Husbandry, Kamdhenu University, Junagadh, Gujarat. The study included a total of 24 dogs that were presented for a various surgical conditions and elective surgeries. The animals were randomly divided into two groups, with twelve animals in each group. All animals were fasted for 12 hours and water was withheld for 6 hours before anaesthesia. All the animals were first premedicated with butorphanol (0.2 mg/kg BW IM) and xylazine (1 mg/kg BW IM) at the same time. After 15 minutes of preanaesthetic medication, induction of anaesthesia was achieved by administration of propofol (1.90 mg/kg BW IV) in Group-I and tiletamine-zolazepam (1.96 mg/kg BW IV) in Group-II. Maintenance of anaesthesia was achieved by administration of propofol (10.11 mg/kg BW IV) in Group-I and tiletamine-zolazepam (2.66 mg/kg BW IV) in group-II. The Haemato-biochemical parameters and clinico-physiological parameters *viz*., heart rate (beats/minute), respiratory rate (breaths/minute), rectal temperature (^{0}F), saturation of oxygen (SpO2) and blood pressure were recorded before administration of preanaesthetic, after induction of anaesthesia and thereafter at every 15-minute interval till completion of surgery.

Results and Discussion

Heart rate and respiration rate

In both groups, a significant decrease in heart rate observed after the induction of anaesthesia, followed by a mild increase that was maintained throughout the observation period. Group II exhibited a higher heart rate due to the use of tiletamine-zolazepam, which stimulates the heart (De Almeida *et al.*, 2000) [7], compared to propofol, which depresses cardiopulmonary function (Lerche *et al.*, 2000) [10]. However, no significant differences in heart rate were observed within groups during the maintenance phase of anaesthesia at different time intervals. Similarly, Kim *et al,* (1999) [9] also recorded significant decrease in heart rate after induction by using propofol in xylazine premedicated dogs. Salve *et al.* (2022) [21] also reported similar findings in dogs premedicated with xylazine, induced and maintained with tiletamine-zolazepam, where they observed a significant decrease in heart rate also at 15, 30, and 45 minutes compared to baseline values.

The respiration rate showed significant decrease after induction of anaesthesia as compared to base value in both groups followed by non-significant alteration throughout maintenance anaesthesia. Significant decrease was observed after induction and at 45, 60 minutes between both groups. Group I exhibited a slightly more significant decrease in the respiration rate after induction of anaesthesia compared to Group II. This difference can be attributed to the fact that propofol, is known to have a depressant effect on respiration (Goodman *et al.*, 1987) [8]. Kim *et al.* (1999) [9] also documented a significant decrease in the respiration rate in dogs when propofol anaesthesia was administered with premedication using xylazine. However, Bayan *et al.* (2002) [2] observed an initial increase followed by a subsequent decrease in the respiration rate after the administration of a propofol in dogs. These findings align with previous studies that have reported a greater incidence of respiratory depression when α2-agonists are administered in combination with butorphanol (Pypendop & Verstegen, 1998) [17].

Table 1: Mean ± SE values of physiological parameters in different groups

Parameter	Group	Preanaesthesia	After induction	15 min	30 min	45 min	60 min
HR (BPM)	I	143.00 ± 6.32^{bA}	98.58 ± 6.09^{aA}	110.25 ± 9.81^{aA}	108.50 ± 8.54^{bA}	114.41 ± 7.41^{aA}	108.75 ± 5.30^{aA}
	II	148.58 ± 8.52^{bA}	122.16 ± 6.86^{aB}	112.16 ± 5.19^{aA}	112.08 ± 3.85^{aA}	113.58 ± 4.02^{aA}	118.25 ± 4.58^{aA}
RR (breath/min)	I	37.16 ± 3.79^{bA}	15.33 ± 1.16^{aA}	18.41 ± 1.52^{aA}	17.41 ± 0.89^{aA}	17.00 ± 0.80^{aA}	16.08 ± 0.75^{aA}
	II	29.25 ± 1.97^{bA}	20.41 ± 1.35^{bB}	17.83 ± 1.10^{bA}	19.50 ± 1.09^{bA}	20.25 ± 0.88^{bA}	19.00 ± 0.44^{bA}
RT (°F)	I	101.8 ± 0.25^{cA}	101.70 ± 0.28^{cA}	101.44 ± 0.33^{bcA}	101.05 ± 0.30^{abcA}	100.80 ± 0.28^{abA}	100.54 ± 0.29^{aA}
	II	102.16 ± 0.14^{eA}	101.97 ± 0.13^{deA}	101.51 ± 0.21^{cdA}	101.07 ± 0.16^{bcA}	100.61 ± 0.19^{abA}	100.15 ± 0.18^{aA}
SpO_2 (%)	I	98.00 ± 0.30^{bA}	90.50 ± 1.06^{aA}	92.58 ± 0.97^{aA}	91.91 ± 0.77^{aA}	92.25 ± 0.60^{aA}	91.50 ± 0.66^{aA}
	II	98.58 ± 0.14^{bA}	93.00 ± 0.91^{aA}	92.83 ± 0.71^{aA}	90.83 ± 0.82^{aA}	91.25 ± 0.75^{aA}	91.33 ± 0.68^{aA}
Systolic arterial pressure (mmHg)	I	155.83 ± 11.53^{aA}	140.25 ± 9.26^{aA}	160.66 ± 10.88^{aA}	146.33 ± 6.72^{aA}	136.00 ± 5.99^{aA}	145.83 ± 4.91^{aA}
	II	155.75 ± 3.36^{cA}	149.16 ± 9.65^{bcA}	147.75 ± 7.97^{bcA}	141.08 ± 5.79^{abcA}	135.25 ± 4.11^{abA}	128.08 ± 3.78^{aB}
Diastolic arterial pressure (mmHg)	I	96.75 ± 4.41^{aA}	85.50 ± 7.09^{aA}	89.58 ± 8.82^{aA}	90.16 ± 6.26^{aA}	89.66 ± 4.99^{aA}	103.16 ± 2.83^{aA}
	II	98.66 ± 4.45^{aA}	94.83 ± 5.65^{aA}	101.25 ± 5.89^{aA}	100.58 ± 3.70^{aA}	96.08 ± 4.47^{aA}	89.91 ± 2.48^{aB}
Mean arterial pressure (mmHg)	I	115.41 ± 5.06^{aA}	102.58 ± 6.76^{aA}	119.75 ± 8.5^{aA}	107.66 ± 4.01^{aA}	104.66 ± 2.45^{aA}	117.83 ± 2.70^{aA}
	II	117.91 ± 3.37^{aA}	112.25 ± 6.78^{aA}	115.83 ± 5.70^{aA}	114.16 ± 3.62^{aA}	107.66 ± 4.19^{aA}	101.91 ± 2.30^{aB}

Means bearing different small alphabet (a, b, c, d) superscript indicates significant difference ($p<0.05$) value within group at different time intervals.

Means bearing different capital alphabet (A, B) superscript indicates significant difference ($p<0.05$) value between group at corresponding time intervals

Rectal temperature

Throughout the observation period, Group II exhibited a significant decrease in rectal temperature. In contrast, in Group I, a significant decrease in rectal temperature was observed specifically at the 15 minute and 30 minute during the observation period. However, for the remaining time intervals, a gradual but non-significant decrease in rectal temperature was observed. Similarly, Yadav (2015) [23] and Chandrakala (2015) [5] also reported significant decrease in rectal temperature in xylazine-propofol anaesthesia. The decrease in rectal temperature might be attributed to various factors including generalized sedation, depression of thermoregulation, reduced basal metabolic rate (BMR), decreased muscle activity, depression of peripheral circulation, and vasodilation (Muir & Gadawski, 1998) [13]. Lu *et al.* (2014) [11] reported decrease in rectal temperature over the time of tiletamine-zolazepam.

Saturation of peripheral oxygen

A significant decrease in SpO2 was observed after the induction of anaesthesia in both groups but decreased was more in propofol group due to its known effect of respiratory depression. Subsequently, a mild, non-significant increase in SpO2 was maintained at various time intervals throughout the surgical period, within each group and between the groups. In all groups, a decrease in respiration rate was observed, which could potentially contribute to the reduced SpO2 levels recorded in the present study. Lu *et al.* (2014) [11] reported non-significant difference was observed throughout observation period in tiletamine-zolazepam anaesthesia. Beths *et al.*, 2001[3] also observed respiratory depression in propofol anaesthesia.

Systolic, diastolic and mean arterial pressure

Systolic arterial pressure (SAP) and mean arterial pressure (MAP) showed non-significant decrease just after induction in both groups but decrease was more in group I compared to group II. Diastolic arterial pressure (DAP) altered non-significantly throughout observation period in both groups. Systolic arterial pressure (SAP), diastolic arterial pressure (DAP), and mean arterial pressure (MAP) showed non-significant different throughout observation except at 60 min where, significant difference was observed in between both groups. Pereira *et al.* (2019) [16] also reported a significant decrease in mean arterial pressure (MAP) at 20 and 30 minutes after the administration of tiletamine-zolazepam. Nam *et al.* (2013) [15] also reported similar findings regarding MAP, where they observed non-significant changes in MAP during the observation period. However, Redondo *et al.* (2000) [19] reported no significant differences in systolic,

diastolic, and mean arterial pressure during xylazine-propofol-halothane anaesthesia reported non-significant differences in SAP, DAP and MAP throughout the observation period in xylazine-tiletamine-zolazepam anaesthesia in dogs, except at 10 minutes where a significant increase was observed. Xylazine is known to cause a reduction in blood pressure, and its use in this study likely contributed to the observed decrease in blood pressure. Propofol administration results in a transient reduction in SBP, DBP and MAP (Cullen & Reynoldson, 1993) [6].

Haemato-Biochemical Parameters

Haematological study revealed significant decrease in mean values of haemoglobin after induction and at 15 minutes as compared to the base value in group I while in group II, significant decrease in mean value of haemoglobin was observed at 15 minutes. In Group I, significant decrease in the mean values of packed cell volume (PCV) was observed after induction and at 30 minutes, compared to the baseline value. In Group II, a significant decrease in the mean value of PCV was observed after induction, at 30 minutes and at 45 minutes, while gradual and non-significant decrease was observed in both groups. In group I, a significant decrease in the mean values of total erythrocyte count (TEC) was observed at 15 minutes compared to the baseline value. In group II, significant increase in mean value of TEC observed after induction followed by non-significant changes up to end of observation period. In both group, non-significant changes were observed in TEC. Saikia *et al.* (2020) [20] reported a significant decrease in haemoglobin, PCV and TEC levels at 30 to 60 minutes after induction with propofol. Chandrakala (2015) [5] reported non-significant changes in the values of haemoglobin and PCV in dogs that underwent propofol-induced and maintenance anaesthesia with xylazine-butorphanol premedication. The observed decrease in Hb and PCV during the maintenance of anaesthesia may be attributed to the phenomenon of haemodilution resulting from CRI of drugs along with normal saline and may also be attributed to the fluid shifting from the extravascular compartment to the intravascular compartment, aiming to maintain normal cardiac output.

Table 2: Mean ± SE values of haematological parameters in different groups

Parameter	Group	Before preanaesthetic	After induction	15 min	30 min	45 min	60 min	After recovery
Hb (g/dL)	I	$11.09_{\pm}0.27^{cA}$	10.88 ± 0.26^{bcA}	10.52 ± 0.27^{abcA}	10.15 ± 0.34^{abcA}	10.02 ± 0.32^{abA}	9.86 ± 0.32^{cA}	9.08 ± 0.34^{cA}
	II	11.47 ± 0.28^{bA}	11.35 ± 0.28^{bA}	11.17 ± 0.29^{abA}	11.00 ± 0.25^{abA}	10.71 ± 0.26^{abA}	10.41 ± 0.29^{aA}	10.33 ± 0.29^{aA}
PCV (%)	I	42.00 ± 0.61^{cA}	40.40 ± 0.81^{bcA}	39.45 ± 0.70^{bA}	38.12 ± 0.99^{bcA}	36.89 ± 0.98^{acA}	35.88 ± 0.86^{aA}	35.93 ± 0.71^{aA}
	II	40.81 ± 0.53^{dA}	39.91 ± 0.61^{cdA}	39.55 ± 0.68^{cdA}	38.27 ± 0.78^{bcA}	36.96 ± 0.58^{abA}	36.03 ± 0.53^{aA}	35.64 ± 0.59^{aA}
TEC (Million/cmm)	I	5.95 ± 0.09^{aA}	6.21 ± 0.07^{bA}	6.00 ± 0.08^{abA}	5.87 ± 0.06^{aA}	5.88 ± 0.05^{aA}	5.92 ± 0.07^{aA}	5.77 ± 0.09^{aA}
	II	5.98 ± 0.09^{abA}	6.23 ± 0.06^{cA}	5.91 ± 0.07^{abA}	5.84 ± 0.09^{abA}	5.75 ± 0.09^{aA}	6.00 ± 0.05^{bA}	5.88 ± 0.05^{abA}
TLC (Thousand/cmm)	I	13.79 ± 0.48^{dA}	12.65 ± 0.43^{cA}	12.19 ± 0.27^{bA}	11.30 ± 0.31^{abA}	11.38 ± 0.23^{bA}	11.01 ± 0.17^{abA}	10.89 ± 0.31^{aA}
	II	16.42 ± 0.38^{dB}	14.92 ± 0.24^{cB}	13.43 ± 0.28^{bB}	12.61 ± 0.24^{abB}	13.40 ± 0.33^{bB}	12.73 ± 0.22^{abB}	12.03 ± 0.24^{aB}
Neutrophils (%)	I	67.03 ± 1.10^{cA}	66.25 ± 0.82^{cA}	66.35 ± 0.88^{cA}	62.39 ± 0.58^{bA}	62.28 ± 0.49^{bA}	60.72 ± 0.47^{bA}	58.17 ± 0.46^{aA}
	II	67.75 ± 1.00^{dA}	66.91 ± 1.26^{dA}	63.94 ± 0.91^{cA}	60.31 ± 0.40^{bA}	61.10 ± 0.75^{bA}	62.75 ± 0.54^{bA}	57.03 ± 0.82^{aA}
Lymphocytes (%)	I	30.32 ± 1.14^{abA}	29.49 ± 0.61^{aA}	29.15 ± 0.76^{aA}	31.99 ± 0.34^{bA}	31.79 ± 0.38^{bA}	34.11 ± 0.65^{cA}	36.34 ± 0.61^{dA}
	II	29.21 ± 1.09^{aA}	29.22 ± 0.86^{aA}	31.44 ± 0.52^{bB}	33.26 ± 0.51^{bcA}	34.00 ± 0.43^{cB}	33.58 ± 0.47^{cA}	36.29 ± 0.74^{dA}

Means bearing small alphabet (a, b, c, d, e) superscript indicates significant difference (p<0.05) within group
Means bearing capital alphabet (AB) superscript indicates significant difference (p<0.05) between group

Significant decrease in mean values of TLC was observed after induction, at 15 minutes and 45 minutes as compared to the base value in group I while in group II, and significant decrease in mean value of TLC was observed after induction, at 15 minutes and 60 minutes. The mean value of neutrophils in group I showed significantly decrease at 30 minutes and after recovery, whereas group II showed a significant decrease at 15 and 60 minutes and after recovery. Gradual and non-significant decreased in neutrophil was observed in both groups during observation period. There was significant difference observed between the groups at 30 and 60 minutes but mean value of neutrophils was within physiological range. The mean value of lymphocyte in group I showed a gradual and significantly increase at 30 minutes, 60 minutes and after recovery, whereas group II showed a significant increase at 30 minutes, 45 minutes, 60 minutes and after recovery. Amarpal *et al.* (1998) [1] reported a decrease in neutrophil following the administration of alpha-2 agonists in dogs. However, Rajankutty (1995) [18] reported increased in neutrophil after induction followed by decreased in tiletamine-zolazepam anaesthesia. He also reported increase in lymphocyte during maintenance anaesthesia after significant decrease at induction and 15 minutes. Yadav (2015) [23] reported non-significant increase in neutrophil (%) up to 60 minutes after propofol induction anaesthesia. The gradual decrease in neutrophil values during anaesthesia ultimately resulted in a relative increase in lymphocyte percentage in this study. Similar results also observed by Surbhi *et al.* (2010) [22].

The mean values of total protein, AST, ALT, BUN and serum creatinine did not show any significant differences within each group or between the groups at any time intervals. Transient and non-significant decrease in the level of serum creatinine and total protein was evident in all the groups. No major complications or adverse effects were observed during entire the study.

Conclusion

These both anaesthetic protocols were effective for anaesthesia in dogs, but it is concluded that tiletamine-zolazepam provided better cardiovascular stability compared to propofol when administered with xylazine and butorphenol premedication. Propofol and tiletamine-zolazepam have minimal impact on hemato-biochemical parameters.

Acknowledgement

Authors are very thankful to the Directorate of Research and Dean PG studies of Kamdhenu University for providing permission and facilities for conducting research.

References

1. Amarpal, Aithal HP, Kinjavdekar P, Pratap K. Physiological, haemodynamic and haematological changes due to medetomidine pethidine induced neurolept analgesia in experimental dogs. Indian J Anim

Sci. 1998;69(2):106-108.
2. Bayan H, Sharma KK, Chakravarty P. A note on the induction of general anaesthesia with propofol in canine. Indian Vet Med J. 2002;26:173-174.
3. Beths T, Glen JB, Reid J, Monteiro AM, Nolan AM. Evaluation and optimization of a target-controlled infusion system for administering propofol to dogs as part of a total intravenous anaesthetic technique during dental surgery. Vet Rec. 2001;148(7):198-203.
4. Wolfensberger BR, Larenza MP. Balanced anesthesia in the equine. Clin Tech Equine Pract. 2007;6(2):104-110.
5. Chandrakala K. Anaesthetic evaluation of some analgesic in combination with xylazine and continuous infusion technique of propofol with special reference to ovariohysterectomy in dogs [dissertation]. Ranchi, India: Birsa Agricultural University; c2015.
6. Cullen LK, Reynoldson JA. Xylazine or medetomidine premedication before propofol anaesthesia. Vet Rec. 1993;132(15):378-383.
7. De Almeida EMPD, Nunes N, Fantinatti AP, Santos PSPD, Bolzan AA, Rezende MLD, *et al.* Cardiorespiratory effects of tiletamine/zolazepam in dogs (*Canis familiaris*) given acepromazin. Braz J Vet Res Anim Sci. 2000;37(3):210-215.
8. Goodman NW, Black AMS, Carter JA. Some ventilatory effects of propofol as sole anaesthetic agent. Br J Anaesth. 1987;59(12):1497-1503.
9. Kim H, Yim R, Kim H, Kim HJ, Yim HR, Kim HY, *et al.* Anaesthetic and cardiovascular effect induced by a combination of midazolazm and thiopenton in dogs. Korean J Vet Clin Med. 1999;16:352-362.
10. Lerche P, Reid J, Nolan AM. Comparative study of propofol or propofol and ketamine for the induction of anaesthesia in dogs. Vet Rec. 2000;146(20):571-574.
11. Lu DZ, Jiang S, Yu SM, Fan HG. A Comparison of Anesthetic and Cardiorespiratory Effects of Tiletamine-Zolazepam/Xylazine and Tiletamine-Zolazepam/ Xylazine/Tramadol in Dogs. Pak Vet J, 2014, 34(1).
12. Muhammad N, Zafar MA, Muhammad G, Masood MZ, Manzoor A, Sarfaraz I, *et al.* Comparative anaesthetic efficacy of propofol, thiopental sodium and combination of propofol with ketamine hydrochloride in dogs. Pak Vet J. 2009;29:1.
13. Muir WW, Gadawski JE. Respiratory depression and apnea induced by propofol in dogs. Am J Vet Res. 1998;59:157-161.
14. Murrell JC. Pre-anaesthetic medication and sedation. In: BSAVA manual of canine and feline anaesthesia and analgesia. BSAVA Library; c2016. p. 170-189.
15. Nam S, Shin B, Jeong S. Anesthetic and cardiopulmonary effects of butorphanol-tiletamine-zolazepam-medetomidine and tramadol-tiletamine-zolazepam-medetomidine in dogs. J Vet Clin. 2013;30(6):421-427.
16. Pereira SA, Henrique FV, Medeiros LK, Silva JK, Goes AB, Vaz AF, *et al.* Anesthetic quality and cardiovascular and respiratory effects of continuous intravenous infusion of tiletamine-zolazepam in bitches. Pesq Vet Bras. 2019;39:214-220.
17. Pypendop BH, Verstegen JP. Hemodynamic effects of medetomidine in the dog: A dose titration study. Vet Surg. 1998;27:612-622.
18. Rajankutty K. General anaesthesia in dogs with tiletamine-zolazepam [dissertation]. Mannuthy, India: Department of Surgery, College of Veterinary and Animal Science; c1995.
19. Redondo JI, Villamandos GRJ, Dominguez JM, Santisteban JM. Propofol halothane and thiopental halothane anaesthesia in 3 dogs. Canine Pract. 2000;24(1):10-13.
20. Saikia B, Sarma KK, Sarma K. Effects of propofol, ketamine and their combination (KETOFOL) as total intravenous anesthesia (TIVA) on haematological, serum biochemical and hormonal profile in the surgical management of canine patients. Indian J Anim Res. 2020;56(7):866-872.
21. Salve PD, Thorat MG, Raulkar RV, Hatzade RI, Ingawale MV, Pawar MB, *et al.* Clinical Efficacy of Tiletamine-Zolazepam and Ketamine-Diazepam Combination on Quality of Anesthesia for Ovariohysterectomy in Dog. Acta Sci Vet Sci. 2022;4(2):51-56.
22. Surbhi, Kinjavdekar P, Amarpal, Aithal HP, Pawde AM, Pathak MC, *et al.* Physiological and biochemical effects of medetomidine-butorphanol propofol anaesthesia in dogs undergoing orthopedic surgery. Indian Vet Surg. 2010;31(2):101-104.
23. Yadav S. Clinical studies on the effect of glycopyrrolate, xylazine, acepromazine, dexmedetomidine and butorphenol in different combinations on propofol-halothane anaesthesia in dogs [dissertation]. Mathura, India: U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya evam Go Anusandhan Sansthan; c2015.