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Effects on blood gas and haematological parameters during butorphanol-dexmedetomidine-tiletamine-zolazepam anaesthesia in cats

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Abstract

The present study was undertaken to evaluate the effects of butorphanol, dexmedetomidine, tiletamine and zolazepam anaesthesia on blood gas and haematological parameters in cats. These parameters were monitored before anaesthetic induction and 10 minutes following anaesthetic induction. Statistical analysis revealed that no significant changes exist and the parameters were within the normal reference range for cats. Therefore, this anaesthetic technique could be employed safely for elective surgery in cats.

Keywords: *Tiletamine, zolazepam, blood gas, cats*

Cats were sympathetically active species, that might cause a fight or flight reaction when handled. They are more elusive than other species due to their small size and agility, posing potential risk to their handlers (Karas, 1999). Cats that are difficult to restrain might require sedation during several procedures, including radiography, dental care, grooming and short surgical procedures (Granholm *et al.,* 2006). Hence, chemical restraint must be considered when feline-friendly handling strategies have failed (Rodan *et al.,* 2011). Chamber or mask induction using inhalant anaesthetics were associated with potential drawbacks such as residual gas pollution, struggling and stress in dogs and cats (Mutoh *et al.,* 1995). Injectable anaesthetic drugs or their combinations could induce surgical anaesthesia, but once the medications were administered, its effects are uncontrollable and might require respiratory assistance (Wiese and Muir, 2007).

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The anaesthetic combination which is used to facilitate blood sampling, should have minimal effects on the cardiovascular system, with minimal impact on haematological variables, in order to generate diagnostically significant results. Hence the present study was conducted with the objective of assessing the effect of butorphanol-dexmedetomidine-tiletamine-zolazepam anaesthesia on the blood gas and haematological parameters in cats.

Materials and methods

Twelve female cats of mixed breeds with age ranging from five months to three and a half years and body weight ranging from 1.8 kg to 3.4 kg presented to University Veterinary Hospital, Kokkalai and Teaching Veterinary Clinical Complex, Mannuthy, were subjected to elective surgical neutering. Signalment and anamnesis of the selected cats presented for elective neutering to the hospitals were gathered and recorded.

In all the cases, food was withheld for 12 hours and water for six hours prior to anaesthetic administration. Each cat received a cocktail of balanced anaesthetic protocol including inj. butorphanol, inj. dexmedetomidine and 1:1 combination of inj. tiletamine and inj. zolazepam at the dose rate of 0.2 mg/kg, 7.5 µg/kg and 7.5 mg/kg body weight respectively, intramuscularly as a combined bolus injection. All the anaesthetised animals were intubated using cuffed endotracheal tube of 2.5 or 3.0 mm size depending on the size of the cat and spaying was performed following standard surgical procedure. The blood samples for haematological studies were collected prior to anaesthetic administration and 10 minutes after induction of anaesthesia. Venous blood samples were collected for the estimation of total erythrocyte count (10^6/µL), total leucocyte count (10^3/µL), haemoglobin concentration (g/dL), volume of packed red cells (per cent), differential leukocyte count (per cent) and platelet count (10^3/µL) which were carried out immediately after collection using automatic haematology analyser (Mythic 18 Vet, Orphee, Geneva, Switzerland). Venous blood samples were also collected in heparin containing vials for the blood gas analysis before administration of the anaesthetics and 10 minutes after induction of anaesthesia, using blood gas analyser (Epoc® Blood analysis system – Siemens Healthineers, India). The data was analysed using SPSS version 24.0. The tests adopted were paired t-test and the level of significance was fixed at five per cent.

Results and discussion

Haematological parameters

The mean value of haematological parameters before induction and 10 min after anaesthetic induction are given in table 1. The mean total erythrocyte count (10^6/µL), mean total leukocyte count (10^3/µL), mean value of haemoglobin concentration (g/dL) and mean volume of packed red cells (per cent) reduced vaguely, ten minutes following induction of anaesthesia. The reduction in these parameters were not statistically significant between observations and were in accordance with the findings of Spada *et al.* (2015).

The mean total platelet count (10^3/µL) prior to the induction of anaesthesia was 110.25 ± 30.67 and it increased moderately to 120.92 ± 33.41, ten minutes following induction. This observation was contradictory to the findings of

Table 1. Comparison of haematological parameters before anaesthetic induction and 10 minutes following anaesthetic induction (Mean ± SE) n = 12

Parameters	Before induction	10 min. after induction	t-value	p-value
Total erythrocyte count (10^6/µL)	8.57 ± 0.35	8.33 ± 0.58	0.638^{ns}	0.536
Total leukocyte count (10^3/µL)	14.47 ± 1.37	14.27 ± 1.15	0.188^{ns}	0.854
Haemoglobin concentration (g/dL)	11.27 ± 0.38	11.00 ± 0.75	0.437^{ns}	0.67
Volume of packed red cells (per cent)	45.62 ± 1.35	43.18 ± 2.52	1.208^{ns}	0.252
Platelet count (10^3/µL)	110.25 ± 30.67	120.92 ± 33.41	0.367^{ns}	0.72

ns non-significant (P>0.05)

Spada *et al.* (2015) and Adarsh (2019). Though an increase in platelet count was noticed during anaesthesia, it was not statistically significant.

The mean granulocyte count (per cent) prior to the anaesthetic induction was 45.47 ± 2.45 and it decreased to 40.93 ± 3.47, ten minutes following induction. There was no significant difference in mean total granulocyte count between the two observations and it was within the acceptable limit for cats. The mean lymphocyte count (per cent) prior to the induction of anaesthesia was 44.56 ± 2.15- and ten-minutes following induction, it increased moderately to 49.17 ± 3.36. Though the lymphocyte count was elevated during anaesthesia, it was not statistically significant and were within normal range for cats. The mean monocyte count (per cent) was 9.97 ± 0.74 prior to the induction of anaesthesia and ten minutes after induction, it reduced slightly to 9.89 ± 0.89. The observation was in accordance with the findings of Spada *et al.* (2015). The reduction noticed after induction of anaesthesia was not statistically significant and were within the reference value for cats (Table 2).

Blood gas parameters

The mean value of blood gas parameters before induction and 10 min after anaesthetic induction are given in table 3.

The mean blood pH in all the animals prior to the induction of anaesthesia was 7.36 ± 0.01 and ten minutes following induction, it increased slightly to 7.37 ± 0.02. The difference in the mean value of blood pH was not statistically significant and was within normal reference range for cats. This observation was contradictory to findings of Hellyer *et al.* (1988), where intravenous administration of tiletamine-zolazepam in cats produced a dose-dependent decrease in arterial pH and ventilation that resulted in respiratory acidosis.

The mean blood $PvCO_2$ (mmHg) was 28.26 ± 1.50 in all the animals prior to anaesthetic induction and it reduced vaguely to 27.97 ± 1.65, ten minutes following induction. The reduction noted after induction of anaesthesia was not statistically significant and the mean blood $PvCO_2$ was within the normal reference limit for cats. The observation was in accordance with the findings of Adarsh (2019), where $PvCO_2$ decreased non-significantly during recovery from anaesthesia with a significant increase in pH.

The mean blood PvO_2 (mmHg) was 151.69 ± 9.00 prior to anaesthetic induction and it reduced slightly to 149.27 ± 10.38, ten minutes following induction of anaesthesia. This reduction was not statistically significant and the observation was contradictory to the findings of Adarsh (2019), where balanced anaesthetic

Table 2. Comparison of differential leukocyte count before anaesthetic induction and 10 minutes following anaesthetic induction (Mean ± SE) n = 12

Parameters	Before induction	10 min. after induction	t-value	p-value
Granulocytes (per cent)	45.47 ± 2.45	40.93 ± 3.47	1.647^{ns}	0.128
Lymphocyte (per cent)	44.56 ± 2.15	49.17 ± 3.36	1.679^{ns}	0.121
Monocyte (per cent)	9.97 ± 0.74	9.89 ± 0.89	0.165^{ns}	0.872

ns non-significant (p>0.05)

Table 3. Comparison of blood gas parameters before anaesthetic induction and 10 minutes following anaesthetic induction (Mean ± SE) n = 12

Parameters	Before induction	10 min. after induction	t-value	p-value
pH	7.36 ± 0.01	7.37 ± 0.02	0.982^{ns}	0.347
PvO_2 (mmHg)	151.69 ± 9.00	149.27 ± 10.38	0.204^{ns}	0.842
$PvCO_2$ (mmHg)	28.26 ± 1.50	27.97 ± 1.65	0.191^{ns}	0.852
HCO_3^- (mmol/L)	15.69 ± 0.56	16.08 ± 0.57	1.048^{ns}	0.317
Base excess (mmol/L)	-9.81 ± 0.56	-9.13 ± 0.56	2.023^{ns}	0.068

ns non-significant (p>0.05)

combination with dexmedetomidine at the dose rate of 10 µg/kg, butorphanol at the dose rate of 0.2 mg/kg, ketamine at the dose rate of 10 mg/kg and midazolam at the dose rate of 0.2 mg/kg body weight, when given intramuscularly in cats, produced a non-significant increase in PvO_2 during recovery from anaesthesia.

The difference in the mean value of blood HCO_3^- (mmol/L) and base excess (mmol/L) prior to anaesthetic induction and ten minutes following induction were not statistically significant and were in accordance with the findings of Adarsh (2019).

Conclusion

The present study confirmed that changes in the mean values of haematological and blood gas parameters, after administration of butorphanol, dexmedetomidine, tiletamine and zolazepam anaesthesia, were not statistically significant and were within the normal reference range for cats. Currently, the available literature regarding the use of this anaesthetic technique in cats was found to be very scarce. Hence this study was conducted and the anaesthetic protocol was found to be safe and effective for elective surgery in cats.

Conflict of interest

The authors declare that they have no conflict of interest.

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