Comparative evaluation of thiopental and propofol as induction agent in dogs

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MASTER OF VETERINARY SCIENCE

IN

VETERINARY SURGERY AND RADIOLOGY

BY

Kaushal

Enrolment No. V- 2106/19

COLLEGE OF VETERINARY SCIENCE AND ANIMAL HUSBANDRY

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(2021)

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This is to certify that the thesis entitled **"Comparative evaluation of thiopental and propofol as induction agent in dogs"** submitted by **Dr. Kaushal,** Enrollment No. **V-2106/19** in partial fulfillment of the requirements for the award of the **Master of Veterinary Science** in **Veterinary Surgery and Radiology** of the **U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan (DUVASU), Mathura (UP),** India, is a bonafide research work carried out by him under my supervision and guidance and no part of the thesis has been submitted for any other degree or diploma.

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We have carefully gone through the contents of the thesis and are fully satisfied with the work carried out by the candidate, which being presented by him for the award of the Degree of this University.

It is further certified that the candidate has completed all the prescribed requirements governing the award of the degree of **Master of Veterinary Science** in **Veterinary Surgery and Radiology** at College of Veterinary Science and Animal Husbandry, U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan (DUVASU), Mathura-281 001 (UP), India.

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%	:	Percent
&	:	And
/	:	Per
@	:	At the rate of
<	:	Less than
=	:	Equal to
>	:	Greater than
±	:	Plus minus
≤	:	Less than or equal to
°F	:	Degree Fahrenheit
µg/ml	:	Microgram per millitre
ABG	:	Arterial blood pressure
ABGE	:	Arterial blood gas analyzer
AI	:	After induction
AR	:	At recovery
ASA	:	American society of anaesthesiology
B/b.wt	:	Body weight
bp	:	Blood pressure
BPL	:	British physical laboratories
bwg	:	Birmingham wire gauze
CV	:	Curriculum vitae
ECG	:	Electrocardiogram
ET	:	Endotracheal tube
et al.	:	Et alia (and others)
Fig.	:	Figure
GABA	:	Gamma-aminobutyric acid
Gr.	:	Group
HCO_3	:	Bicarbonate
hr	:	Hour
HR	:	Heart rate
I/M	:	Intramuscular
I/V	:	Intravenous

Inj.	:	Injection
Lmt.	:	Limited
MAP	:	Mean arterial pressure
mg	:	Milligram
ml	:	Milliliter
mm	:	Millimeter
mmHg	:	Millimeter of mercury
N	:	Number
n	:	Number
P	:	Atrial depolarization
p value	:	Probability value
PA	:	Pre-anaesthetic
$PaCO_2$	:	Partial pressure of carbon dioxide
PaO_2	:	Partial pressure of oxygen
PE	:	At peak effect
pH	:	Potential of hydrogen
PR	:	Pulse rate
Pvt.	:	Private
QRS	:	Ventricular depolarization
RR	:	Respiration rate
RT	:	Rectal temperature
S. No	:	Serial number
S.D.	:	Standard deviation
S/C	:	Subcutaneous
SAP	:	Systolic blood pressure
SBP	:	Systolic blood pressure
SpO_2	:	Oxygen saturation of haemoglobin
T	:	Ventricular repolarization
VBG	:	Venous blood pressure
Viz	:	Namely

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(Kaushal)

CONTENTS

ABSTRACT

Two anaesthetic protocols were evaluated in two groups (A and B) of animals presented for musculoskeletal surgical conditions. Each group consisted of 6 animals. As preanaesthetics combination a mixture of glycopyrrolate (0.01mg/kg), butorphanol (0.2 mg/kg) and midazolam (0.2 mg/kg) was administered intramuscularly in the animals of group A and B. In both groups, 10 min after administration of preanaesthetics, anaesthesia was induced with 2.5% thiopental @ 10 mg/kg b.wt, propofol (10mg/ml) @ 4mg/kg b.wt given slow intravenously, to effect using small boluses until a plane of anaesthesia suitable for endotracheal intubation was achieved. Soon after the desired level of anaesthesia was achieved, endotracheal intubation was performed and maintenance of anaestheisia in both the groups was started with isoflurane using semiclosed rebreathing system of anaesthesia with a oxygen flow rate of 30 ml/kg/min. The vapourizer was set at 2% initially and then increased or decreased in increments as per the need to maintain an adequate level of anaesthesia throughout the surgical procedure. Anesthesia was maintained for at least 45 minutes or until the surgical procedure was completed.

The effects of these anaesthetic combinations were evaluated on the basis of alteration in physiological, blood gas and cardiovascular parameters. These parameters were recorded at before pre-anaesthetics (PA), after induction (AI), at peak effect (PE) and at recovery (AR).

Preanaesthetics combinations used in group A and B produced mild-moderate sedation. In group A, the dose required for induction of anaesthesia and intubation in five out of six dogs was less than 10 mg/kg whereas, it was less than 4 mg/kg in five dogs of group B and this is in agreement with the recommendations. Palpebral reflex and pedal reflex remained completely abolished during post induction and maintenance period in all the groups.

Physiological (RT, RR and PR), blood gas (pH, $PaCO_2$, PaO_2 and HCO_3^-) and cardiovascular parameters (SBP, SpO_2 and ECG) in animals of both the groups altered within physiological limit except pH (at PE of ABG and AR of VBG), PaO_2 and HCO_3^- (at AI & PE).

On the basis of the observations on physiological, blood gas and cardiovascular changes no major deleterious effect was observed in either group A or B and the dogs made uneventful recovery from anaesthesia.

Introduction

CHAPTER- 1

INTRODUCTION

Injectable anaesthetics such as thiopental and Propofol are suitable for rapid induction of anaesthesia. However, they cause cardiopulmonary changes such as apnea, bradycardia, tachycardia, hypotension or hypertension in a dose-dependent manner (Muir and Gadawski, 1998).

Pre-anesthetic medications such as tranquilizers, sedatives, and opioids are used with the aim to achieve smooth induction of anaesthesia and reduced stress on animals. Administration of pre-anesthetic medications also reduces the required dose of injectable anaesthetic needed for induction and results in fewer adverse effects or effects of lesser severity (Bufalari et al., 1997).

Propofol is an intravenous anaesthetic which is used during the surgical procedures for maintaining sedation, during monitored anaesthesia care as well as an induction agent for general anaesthesia. It may be administered intravenously as a bolus or an infusion or some combination of the two (Smithburge et al., 2019; Zhang et al., 2019; Heim et al., 2019). It is an intravenous hypnotic drug used for induction and maintenance of sedation and general anaesthesia (Sahinovic et al., 2018).

Thiopentone/Thiopental sodium belongs to ultrashort acting class of barbiturates with a narrow safety margin and can be given as general anaesthetic. However, the ultrashort acting barbiturates produce a defined but a very short duration of anaesthesia. The depth of anaesthesia produced depends upon its concentration in blood and brain tissue (Ilkiw et al., 1991). Thiopental is not a complete anaesthetic and is always given in conjunction with another drug(s). It is used to induce and maintain sleep; complete anaesthesia (amnesia, analgesia and reflex suppression) may be provided by the anaesthetic gases (Breivik et al., 1978; Turcant et al., 1985).

Inhalant volatile anaesthetics are known to reduce cerebral metabolic rate, depress respiration, variably affect the pain threshold, causes direct myocardial depression and a decrease in sympathoadrenal activity (Steffey and Mama, 2007). Isoflurane a volatile inhalant anaesthetic, is currently most favored agent in veterinary

medicine, although after its used vasodilation is reported to increase with increase in depth of anaesthesia contributing to hypotension but its myocardial depressant effect is far less than halothane (Seahorn, 2001). In the present work, isoflurane was used at 1.5-2.0 percent vaporizer setting for maintenance of general anaesthesia throughout the required duration of the procedure. In the literature reviewed, isoflurane is recommended for maintenance of anaesthesia at 1.5 to 2.5 percent (Bednarski, 2007) and the concentration employed in the present work was found adequate and within the recommended limit.

Midazolam is a 1,4-benzodiazepine derivative with a unique chemical structure, depending on environmental pH. It contributes to rapid onset of action and to good local tolerance after parenteral administration (Kanto et al., 1985). Midazolam is readily distinguished from other benzodiazepines because of its rapid onset and short duration of action, low incidence of thrombophlebitis and pain on site of injection, and minimal cardiovascular and respiratory effects. The physicochemical properties of midazolam allow for enhanced water solubility, which limits physicochemical incompatibilities (Fragen et al., 1997).

Butorphanol is a synthetic mixed agonist-antagonist compound of the morphinan series. It has a profile of action similar to pentazocine but with greater analgesic efficacy and lesser side effects (Miyoshi et al., 2001). Butorphanol is rapidly absorbed after parenteral administration and has a distribution half-life of 5 minutes. It is converted to the inactive metabolites hydroxybutorphanol and norbutorphanol (Ferrante et al., 1993) and also has agonistic activity at the κ-receptor and antagonistic activity at the μ-receptor thus is a poor monoanalgesic. It also exhibits partial agonistic activity at the σ-receptor (Pallasch et al., 1985).

Anticholinergic drugs are recommended for the treatment of vagally-induced bradycardia during Anaesthesia, and occasionally suggested for prevention of its occurrence, if a profound opioid analgesic is used (Thurmon et al., 1996). Glycopyrrolate a synthetic quaternary ammonium antimuscarinic agent has received attention for anaesthetics use in veterinary medicine (Riviere & Papich, 2009). It has distinct advantage over classical pre-anesthetic anticholinergic agent atropine due to its inability to cross the blood brain barrier.

Considering the merit of using glycopyrrolate, butorphanol and midazolam as a pre-anaesthetic, the present work has been conducted using thiopental and propofol as a induction agent with the following objectives.

OBJECTIVES

The present study is being proposed to be undertaken with the following objectives:

Comparison of induction agents on the basis of changes in:

1) Physiological parameters
2) Blood gas analysis
3) Some cardiovascular parameters
4) Summarization of the findings of comparative study of two induction agents for clinical anaesthesia.

Review of Literature

CHAPTER-2

REVIEW OF LITERATURE

The literature reviewed regarding use of thiopental and propofol as induction agent for general anaesthesia in dogs and the relevant pre-anaesthetic medications as relevant to the present work is given hereunder. The effect of such agents on various parameters as mentioned in reviewed literature is also included.

Muir and Hubble (2000) informed that pre-anaesthetic medication is an essential part of safe anaesthetic management. When used appropriately, this minimise stress, cardiopulmonary depression, and the deleterious effects associated with many intravenous and inhalation anaesthetics and has a dose sparing effect on the dose of injectable anaesthetic and inhalant anaesthetics. They also mentioned that intravenous and intramuscular drugs can be used to induce chemical restraint and general anaesthesia. Proper use of pre-anaesthetic medication (a tranquillizer, sedatives, analgesics) is imperative if anaesthetic drugs are to produce the desired effect and if the side effect is to be avoided. Injectable anaesthetic drugs are often more convenient and economical than inhalation anaesthetics.

Gangwar et al. (2010) reported that the good quality of anaesthesia was induced by a combination of drugs that are having a different predominant mechanism of action. Further they stated, the combination of complementary drugs permits the use of a decreased dose of each drug to achieve anaesthesia, decrease their commensurate side effects and it also increases the safety of anaesthesia.

An ideal anaesthetic produces sleep, amnesia, analgesia and muscle relaxation. As all these characteristics cannot be provided by a sole agent, hence a combination of drugs is used (Dewangan and Tiwari, 2016).

2.0 Physiological observations

2.1 Rectal temperature

Manat (2001) did a anaesthetic study in 12 dogs in acepromazine premedicated dogs in group I using propofol and in the group II using a mixture of 2.5 % thiopental and 1 % propofol. They found that in animals of group I there was non-significant gradual decrease in body temperature up to 60 minutes after induction.

They concluded that the decrease in temperature was a result of peripheral vasodilation, decrease in basal metabolic rate, muscle tone and depression of thermoregulatory mechanisms produced by general anaesthesia.

A study was carried out to identify the comparative efficacy of propofol alone at two dosages, thiopental sodium and propofol in combination with ketamine hydrochloride in dogs. For this purpose, 24 healthy stray dogs were randomly divided into four equal groups viz. A, B, C and D. Groups A and B were treated with propofol at the dose rates of 6 and 10 mg/kg b.wt. respectively, while group C was given propofol and ketamine hydrochloride in combination @ 4 mg/kg b.wt. each and group D was treated with thiopental sodium @ 20 mg/kg b.wt. They observed that body temperature decreased in dogs of all the groups within 5 minutes of administration of anaesthetic agents. However this decrease was marked in groups A and C, other two groups showed continuous decrease in body temperature up to 20 minutes (Muhammad et al., 2009).

Jena et al. (2014) carried out evaluation and comparison of the physiological, hemodynamic and hematobiochemical effects in response to different total intravenous anaesthesia techniques using xylazine or dexmedetomidine with propofol in canine patients. Under this clinical study, 12 apparently healthy adult dogs (14.27±3.2 kg) divided into two groups (n=6). Animals were administered with xylazine (0.5 mg/kg body weight IV) in X group or, dexmedetomidine (10 μg/kg body weight IV) in D group and propofol (as IV bolus till the induction and continuous IV infusion for maintenance). They reported that the rectal temperature decreased in all the groups after the administration of pre-anaesthetics which was a result of CNS depression in combination with a reduction in muscular activity and basal metabolic rate. They concluded that induction of anaesthesia with propofol caused a further significant decrease in the rectal temperature.

In a study on the effects of thiopental and propofol on cardiopulmonary functions when used as an induction agent prior to isoflurane anaesthesia in the rhesus monkey was carried out. Eight healthy rhesus monkeys weighing 3.72 to 5.7 kg, 4-5 years old were used in the study. It was observed that in both the groups, core temperature decreased significantly over a 60 minute of time relative to baseline levels, with no significant group-wise differences (Choi et al., 2016).

Clinical and haemato-biochemical effects of ketamine and thiopental as induction agents for isoflurane anaesthesia was studied in 12 clinical cases of dogs aged between 1 year to 10 years presented for routine surgical procedures *viz*. castration and ovariohysterectomy. All the dogs were uniformly premedicated. In the six dogs of group I, ketamine was used as an intravenous anaesthetic induction agent. In dogs of group II, anaesthesia was induced by intravenous administration of thiopental sodium as a 2.5 per cent solution. It is reported that in the dogs of group II, the mean rectal temperature before induction, during anaesthesia and after recovery were recorded in gradually decreasing trend as 102.48 ± 0.44°F, 99.77 ± 0.39°F and 99.98 ± 0.35°F respectively (Sravanti et al., 2016).

On the basis of a study in 5 female dogs of 1- 1.5 years of age admitted for elective ovariohysterectomy, premedicated with atropine sulphate, s/c @ 0.04 mg/kg b.wt. 5 min prior to each treatment, xylazine @ 1 mg/kg b.wt. tramadol @ 3 mg/kg b.wt. IM thereafter propofol to effect" IV 15 min later and maintained by C.R.I method of propofol @ 0.3 mg/kg b.wt./min, it is reported that there was a non-significant ($P>0.05$) decrease in the rectal temperature at 10 min (102.04±0.26), 20 min (101.76±0.25) and 30 min (101.42±0.32) intervals and thereafter it decreased further and turned out to be significant ($P<0.05$) in comparison to the baseline throughout the observation period (Chandrakala et al., 2017).

A study on 12 healthy dogs was conducted to evaluate hemato-biochemical and clinic-physiological effects in addition to the anaesthetic properties of propofol alone or in combination with diazepam, ketamine HCl or thiopental sodium. It was observed that the rectal temperature decreased after induction of anaesthesia in both the groups (Shabaan et al., 2018).

A study on 12 clinical cases of dogs were conducted for various surgical procedures which later on were divided into two equal groups *viz.,* group 1 anaesthetized with intravenous propofol (@ 4 mg/kg body weight) and in group 2 with ketofol (1:1 propofol-ketamine) @ 4 mg/kg body weight intravenously. Group 1, a significant drop in rectal temperature from 100.55 to 99.40 °F occurred which was due to hypotensive action of propofol whereas, in ketofol, the rectal temperature ranged from 100.87 to 99.79 °F which was a resultant effect of ketamine component on limbic-hypothalamic centres which elevates the body temperature (Shinde et al., 2018).

2.2 Respiratory rate

A clinical study of 12 dogs in two groups was carried out in acepromazine premedicated dogs in group I using propofol and in the group II using a mixture of 2.5 % thiopental and 1 % propofol. It was reported that there was a non-significant decrease in the respiratory rate in both the groups, while in the initial 10 minutes there was a significant decrease. It was concluded that the depression in respiratory rate was a result of propofol-thiopental's depressant effect on the medullary respiratory centre (Manat, 2001).

A comparative study on the anaesthetic and cardiopulmonary effects of a diazepam-ketamine combination with thiopental for induction of anaesthesia was carried out in twenty healthy dogs of various breeds weighing between 3.8 and 42.6 kg undergoing major orthopaedic or soft tissue surgery. It was observed that the baseline values of respiratory rate decreased from 12±13 to 11±7 after 10 minutes from induction (White et al., 2001)

A study was carried out to evaluate the cardio-respiratory effects of the combination of medetomidine and thiopental followed by reversal with atipamezole as a combination for anaesthesia in 10 healthy German shepherd dogs. Medetomidine (0.010 mg/kg) was administered intravenously and blood pressure and heart rate were recorded every minute for 5 minutes. Thiopental was then slowly administered until intubation conditions were ideal. In healthy dogs a decrease in respiratory rate from 71.8 to 12.2 was seen after induction. Respiratory rates slowly increased over the next hour to 27 and a further increase to 51.4 after the administration of atipamezole ($P < 0.05$) (Joubert and Lobetti, 2002).

A study in six young adult medium-sized healthy crossbred dogs was conducted to compare the cardiopulmonary effects of continuous rate infusions (CRI) of alfaxalone-2-hydroxypropyl-B (beta)- cyclodextrin (HPCD) and propofol. They observed that in the propofol group the baseline of respiratory rate was 21±8 which was decreased to 7±3 after 5 minutes from induction (Ambros et al., 2008).

A comparative study was carried out on fourteen healthy crossbred bitches, aged 0.5-5 years and weight 16-42 kg to know the anaesthetic and cardiopulmonary effects of alfaxalone with propofol when used for total intravenous anaesthesia (TIVA) during ovariohysterectomy in dogs. It was observed that in the propofol group

the baseline of respiratory rate was 18±6 which decreased to 14±7 after 5 minutes from induction (Suarez et al., 2012).

A study was carried out to know the effects of thiopental and propofol on cardiopulmonary functions as an induction agent prior to isoflurane anaesthesia in the rhesus monkey. Eight healthy rhesus monkeys weighing 3.72 to 5.7 kg, 4-5 years old, were used in the study. It was observed that in both the groups, the respiratory rate decreased and the respiratory rate gradually and significantly decreased in thiopental group up to 45 minutes following induction of anaesthesia. Meanwhile, propofol group showed a slight decrease in respiratory rate, as compared to the monkeys treated with thiopental. After withdrawal from isoflurane, the decreased respiratory rate was immediately restored in propofol rather than thiopental groups (Choi et al., 2016).

A clinical study on 12 healthy dogs were conducted to identify the haemato-biochemical and clinico-physiological effects in addition to the anaesthetic properties of propofol alone or in combination with diazepam, ketamine HCl or thiopental sodium. It was observed that the respiratory rate which was 17.33±1.76 per minute 15 minute before induction of anaesthesia increased to 18.00±1.53 per minute after 15 minutes from induction in propofol group while in the group receiving thiopental-propofol mixture it was 17.00±1.15 per minute 15 minute before anaesthesia which increased to 20.00±0.00 per minute after 15 minute from induction (Shabaan et al., 2018).

A study was conducted in twelve cases of dogs presented for various surgical procedures, which were later divided into two equal groups *viz.,* group 1 anaesthetized with intravenous propofol (@ 4mg/kg body weight) whereas group 2 with ketofol (1:1 propofol-ketamine @ 4mg/kg body weight intravenously). A significant respiratory depression was observed between intervals in propofol group ranging from 15 to 12 in a span of 60 minutes (Shinde et al., 2018).

2.3 Heart rate

A study in two groups of total 12 clinical cases of dogs was done in acepromazine premedicated dogs in group I using propofol and in the group II using a mixture of 2.5 % thiopental and 1 % propofol. A significant increase in mean heart

rate values in both the groups occurred which was attributed to sympathetic activation following a loss of consciousness (Manat, 2001).

A comparative study on cardiopulmonary effects of a diazepam-ketamine combination with thiopental for induction of anaesthesia in twenty healthy dogs of various breeds weighing between 3.8 and 42.6 kg undergoing major orthopaedic or soft tissue surgery was conducted. It was observed that the baseline values of the heart rate increased from 106.00 ± 21.00 to 115.00±42.00 after 10 minutes from induction (White, 2001).

Joubert and Lobetti (2002) conducted a study to evaluate the cardio-respiratory effects of the combination of medetomidine and thiopental followed by reversal with atipamezole as a combination for anaesthesia in 10 healthy German shepherd dogs. Medetomidine (0.010 mg/kg) was administered intravenously and blood pressure and heart rate were recorded every minute for 5 minutes. Thiopental was then slowly administered until intubation conditions were ideal. It was observed that in healthy dogs, heart rate decreased from 96.7 at baseline to 38.5 5 minutes after the administration of medetomidine ($P < 0.05$). The heart rate then increased with the administration of thiopental to 103.2 ($P < 0.05$).

Dennis et al. (2007) performed a study in which sixty-four dogs were randomly assigned to receive either thiopental or propofol and their electrocardiograms were recorded immediately before and shortly after they were anaesthetized. They observed that both thiopental and propofol caused an initial increase in heart rate and decrease in vagal tone, However the change in both variables was significantly greater with propofol.

Ambros et al. (2008) conducted a study in six young adult healthy crossbred dogs to compare the cardiopulmonary effects of continuous rate infusions (CRI) of alfaxalone-2-hydroxypropyl-B(beta)-cyclodextrin (HPCD) and propofol. In the propofol group the baseline of heart rate was 99.00±34.00 which decreased to 77.00±7.00 after 5 minutes from induction.

A study was performed to evaluate the quality of anaesthetic induction and cardiorespiratory effects following rapid intravenous (IV) injection of propofol or alfaxalone in sixty healthy dogs anaesthetized for elective surgery or diagnostic procedures. Premedication was done using acepromazine (0.03 mg/ kg) and

meperidine (pethidine 3 mg /kg) intramuscularly. For anaesthetic induction dogs, received either 3 mg kg propofol (Group P) or 1.5 mg/kg alfaxalone (Group A) by rapid IV injection. They reported that on induction heart rate decreased in Group P (-2 ± 28 beats minute) however increased in Group A (14 ± 33 beats minute). The difference was significant (Amengual et al., 2012).

Suarez *et al.* (2012) carried out an study on fourteen crossbred bitches aged 0.5-5 years and weight 16-42 kg to compare the anaesthetic and cardiopulmonary effects of alfaxalone with propofol when used for total intravenous anaesthesia (TIVA) during ovariohysterectomy. It was observed that in the propofol group, the baseline of heart rate was 108.00±18.00 which decreased to 99.00±19.00 after 5 minutes from induction.

Choi et al. (2016) performed a study to evaluate the effects of thiopental and propofol on cardiopulmonary functions when used as an induction agent prior to isoflurane anaesthesia in the rhesus monkey. Eight healthy rhesus monkeys weighing 3.72 to 5.7 kg, 4-5 years old, were used in the study. It was observed that in both the groups, the values of heart was decreased.

Cattai et al. (2018) conducted a study to evaluate the haemodynamic changes during induction of general anaesthesia with propofol in healthy dogs, by beat-to-beat continuous monitoring. All dogs were premedicated with intramuscular acepromazine (0.015 mg/kg) and methadone (0.15 mg/kg). It was observed that the median (range) heart rate was significantly higher ($p = 0.006$) at the moment of maximum hemodynamic depression (T peak) [105(70–148) bpm] compared with pre-induction values (T0) [65(50–120) bpm].

Shabaan et al. (2018) performed a study on 12 clinically healthy dogs to evaluate haemato-biochemical and physiological effects in addition to the anaesthetic properties of propofol alone or in combination with diazepam, ketamine HCl or thiopental sodium. They observed that the heart rate which was (44.00±1.53) per minute 15 minutes before induction was increased to (56.00±8.72) per minute 15 minute after induction of anaesthesia in propofol group while in the group receiving thiopental-propofol mixture it was (50.67±3.48) per minute 15 minutes before induction which increased to (70.00±4.62) per minute15 minute after induction of anaesthesia.

Shinde et al. (2018) carried out a study on 12 clinical cases of dogs presented for various surgical procedure which were divided into two equal groups *viz.* group 1 anaesthetized with intravenous propofol (@ 4 mg/kg body weight) whereas in group 2 ketofol (1:1 propofol-ketamine) @ 4 mg/kg body weight was administered intravenously. They reported that the heart rate significantly increased from 0 minute to 15 minutes in both groups i.e. 78.83 to 112.67 in group 1 and 67.00 to 114.33 in group 2 which was attributed to the effect of atropine in premedication.

3.0 Blood gas variations

Lopes et al. (2015) carried out a study to compare the cardiopulmonary parameters in propofol or thiopental-anesthetized dogs induced to pulmonary hypertension by serotonin. All the animals were randomly assigned to two groups: propofol and thiopental group, after that propofol was used for induction (8±0.03 mg/kg) and maintenance (0.8 mg/kg/minute), while in thiopental group was used (22±2.92 mg/kg; 0.5 mg/kg/minute respectively). The measurements were performed before administration of 5ht, after 30 minutes, then at 15-minute intervals i.e t0, t30, t45, t60, t75, t90. They found a decrease in arterial partial pressures of oxygen (PaO_2) from t60 in case of propofol group while decrease from t30 to t90 in case of thiopental group. They also found increase in $PaCO_2$ from t30 while these parameters were stable in case of thiopental group.

Enouri et al. (2008) carried out a study to evaluate the cardiopulmonary effects of anesthetic induction with thiopental, propofol, or ketamine hydrochloride and diazepam in 6 adult healthy dogs sedated with medetomidine and hydromorphone. They found decrease in PaO_2 and pH after induction with thiopental and propofol. While increase in PaO_2 and further decrease in pH during 5 to 25 minutes of administration of isoflurane. They also observed increase in $PaCO_2$ while decrease in base excess after induction with thiopental and propofol and also during maintainance from isoflurane.

Gonclaves et al. (2009) reported that the only blood gas values that differed significantly were the arterial oxygen partial pressure in propofol anaesthesia in dogs. He also observed that there were no significant differences between inspired oxygen fraction levels or measurement times in arterial carbon dioxide partial pressure, arterial haemoglobin saturation, base deficit, bicarbonate concentration, pH, venous oxygen partial pressure, venous carbon dioxide partial pressure.

Maney et al. (2013) conducted a study to compare the physiological parameters, arterial blood gas values, induction quality, and recovery quality after IV injection of alfaxalone or propofol in dogs. They assigned the dogs to receive up to 8 mg/kg propofol or 4 mg/kg alfaxalone, to effect, at 10% of the calculated dose every 10 seconds. Parameters like temperature, pulse rate, respiratory rate, direct blood pressure and arterial blood gases were measured before induction, immediately post-induction and at 5-minute intervals until extubation. They found that pH, PaO_2 were significantly lower while $PaCO_2$ and HCO_3 were significantly higher post induction as compared to baseline in case of propofol. They also found no significant difference in blood gas values immediately post induction and at every 5 minutes interval until extubation between propofol and alfaxolone.

Sams et al. (2008) conducted a study to determine the effects of propofol or etomidate on induction quality, arterial blood pressure, blood gases and recovery quality in normal dogs. All the Dogs were randomly assigned to receive propofol at 8 mg/kg or etomidate at 4 mg/kg intravenously (IV) to effect. Midazolam was administered at 0.3 mg/kg IV as pre-medication at least 1 minute prior to induction. Direct arterial blood pressure, arterial blood gases, and heart rate were obtained at baseline, before induction, after induction and for every 5 minutes afterwards until the dog began to swallow and the trachea was extubated. They observed that Propofol caused decrease in SAP and MAP which was not observed with etomidate and there was increase in heart rate, $PaCO_2$, and HCO_3 and decrease in the PaO_2 and SaO_2 in the propofol group compared with the etomidate group after induction.

Fukushima et al. (2011) conducted a study to know the cardiorespiratory and blood gas alterations during laparoscopic surgery for intra-uterine artificial insemination in six healthy dogs. All the animals were pre-medicated with acepromazine (acepran; univet, campinas, brazil), @ 0.05 mg/kg body weight and pethidine (dolosal; cristália, brazil), @ 3.0 mg/kg b.wt. both intramuscularly. Later anaesthesia was induced using 1% propofol (Fresofol; fresenius kabi, brazil), @ 5.0 mg/kg intravenously, followed by orotracheal intubation and maintenance with isoflurane (isothane; baxter, brazil) in a semi-closed circuit and spontaneous breathing. Various parameters like heart rate, respiratory rate, body temperature, venous blood ph, partial pressure of co_2 and oxygen, oxygen saturation, total carbon

dioxide (tco_2) and bicarbonate were monitored. Significant alterations noticed were hypercapnia, hypoventilation, and respiratory acidosis.

Congdon et al. (2013) conducted a study on five adult male Walker Hound dogs 1–2 years of age averaging 25.4±3.6 kg to evaluate the cardiovascular, respiratory, electrolyte and acid-base effects of a continuous infusion of dexmedetomidine during propofol-isoflurane anaesthesia following premedication with dexmedetomidine. Dogs were sedated with dexmedetomidine @ 10 µg/kg IM, 78±2.3 minutes (mean ± SD) before general anaesthesia. Later anaesthesia was induced with propofol (2.5±0.5 mg/kg) IV and maintained with 1.5% isoflurane. Thirty minutes later dexmedetomidine @ 0.5 mg/kg IV was administered over 5 minutes followed by an infusion of 0.5 kg/hr. Cardiac output (CO), heart rate(HR), ECG, direct blood pressure, body temperature, respiratory parameters, acid-base and arterial blood gases and electrolytes were measured 30 and 60 minutes after the infusion started. Data were analyzed via multiple linear regression modeling of individual variables overtime, compared to anaesthetized baseline values. No statistical difference from baseline for any parameter was measured at any time point. No differences were found in respiratory rates, PaO_2, $PaCO_2$, pH, base excess, bicarbonate, sodium, potassium, chloride, calcium or lactate measurements before or during infusion.

Pang et al. (2009) conducted a study on 18 ASA I/II and five healthy dogs to assess the suitability of lingual venous blood (LBG) as an alternative to arterial blood (ABG) samples in determining acid-base balance and blood-gas status in dogs anesthetized for elective procedures with medetomidine and isoflurane. Blood sampling was simultaneously performed at dorsal pedal arterial and lingual venous sites, generating paired data. Two paired samples were collected from each dog in the clinical part and four from each dog in the experimental part (two during isoflurane anaesthesia and two during isoflurane plus medetomidine). The pH and PCO_2 of LBG samples provide clinically acceptable substitutes of ABG samples in the dog population studied. The wider limits of agreement for PO_2 render it less reliable as a substitute for ABG. The difference in PO_2 identified between LBG and ABG during medetomidine administration may not preclude the use of LBG as substitutes for ABG samples.

Laythm al- kattan. (2013) conducted a study on twelve adult healthy dogs of both sexes via closed system of anaesthesia. The animals were divided into two groups having six animals in each. The first group was treated with a protocol of thiopental sodium @ 20 mg/kg b.wt. I.V, premedicated with diazepam. The second group was treated with protocol of propofol I.V. (2 mg/kg b.wt.) premedicated with diazepam and undergoing pneumoperitoneum with CO_2 anaesthesia maintained with halothane 2%. The anesthetic, behavioral, biochemical changes were recorded during different periods. The results showed respiratory depression but marked hypoxia not observed at early duration of anaesthesia. The endotracheal tube freely introduced within 3-2.5 min. The CO_2 gas smoothly delivered into the abdomen without serious complications. In the second group, the induction was rapid with smooth and unexcited recovery and excellent muscle relaxation. He concluded that the two combination proved to be an effective anaesthetic protocol and adequate for minor rapid surgical interventions.

4.0 Cardiovascular parameters

Choi et al. (2016) performed a study to evaluate the effects of thiopental and propofol on cardiopulmonary functions when used as an induction agent prior to isoflurane anaesthesia in the rhesus monkey. Eight healthy rhesus monkeys weighing 3.72 to 5.7 kg, 4-5 years old, were used in the study. They observed that in both the groups, the values of systolic blood pressure, mean blood pressure, diastolic blood pressure were decreased. Systolic blood pressure was significantly lowered in the thiopental group when compared to propofol group. They concluded that propofol provides a minor suppression in systolic arterial blood pressure than thiopental sodium.

Cattai et al. (2018) carried out a study to evaluate the haemodynamic changes during induction of general anaesthesia with propofol in healthy dogs. All dogs were premedicated with intramuscular acepromazine (0.015 mg/kg) and methadone (0.15 mg/kg). Later he used propofol 5 mg/kg over 30 s followed by a continuous infusion of 25 mg/kg/h, to induce and maintain anaesthesia. He concluded that the there was a decrease in blood pressure when propofol was used as a induction agent.

Wouters et al. (1995) carried out a study to examine hemodynamic changes during induction of anaesthesia with eltanolone, a new short-acting steroid hypnotic, as compared to propofol. Doses of each drug were investigated as eltanolone 2.5 and

5 mg/kg and propofol 7.5 and 15 mg/kg. They observed decrease in arterial blood pressure after using propofol as an induction agent in dogs.

Musk et al. (2005) carried out a study on using target-controlled infusions of propofol designed to achieve 2·5 µg/ml, 3·0 µg/ml, 3·5 µg/ml or 4·0 µg/ml of propofol in blood. In this study he recorded the arterial blood pressure oscillometrically just before induction and at times 0, 3 and 5 min. Observe. They observed that there was a significant decrease in arterial blood pressure between just before induction and time 3 and 5 minutes.

White et al. (2001) had a study to compare the anaesthetic and cardiopulmonary effects of a diazepam-ketamine combination with thiopental for induction of anaesthesia in twenty healthy dogs undergoing major orthopaedic or soft tissue surgery. Pre-anaesthetic medications like acepromazine and methadone were given intramuscularly 30 minutes before induction of anaesthesia. Each animal was then randomly assigned to receive either thiopental or diazepam and ketamine. Anaesthesia was maintained with halothane in oxygen and nitrous oxide and heart rate, respiratory rate, systolic blood pressure, end tidal carbon dioxide tensions and oxygen saturation were recorded at 10 minute intervals throughout surgery. They found that there was no significant difference in systolic blood pressure values between thiopental or diazepam and ketamine combination.

Manat (2001) carried out a study on general anaesthesia using propofol alone (group i) and propofol-thiopental (group ii) for induction and maintenance of anaesthesia after premedication with acepromazine in twelve clinically healthy dogs of either sex, allotted to two groups of six animals each. He found that there was non-significant decrease in oxygen saturation in all the animals having induction with propofol.

Hofmeister et al. (2008) performed a study to determine the effects of propofol or thiopental induction on intraocular pressures (IOP) in normal dogs. They randomly assigned the dogs to receive propofol @ 8 mg/kg IV (group P) or thiopental @ 18 mg/kg IV (group T) until loss of jaw tone. Direct arterial blood pressure, arterial blood gasses, and IOP were measured at baseline, after preoxygenation but before induction, before endotracheal intubation, and after intubation. They found that there was no significant relationship between any cardiovascular or blood gas parameter and IOP at any time.

Henao and Ricco (2014) carried out a study to evaluate the cardiorespiratory effects of IV administration of propofol (4 mg/ kg), ketamine hydrochloride and propofol (2 mg/kg each; K-P), or ketamine hydrochloride (5 mg/kg) and diazepam (0.2 mg/kg; K-D) before and after induction of anaesthesia in dogs sedated with acepromazine maleate and oxymorphone hydrochloride. Each dog was randomly allocated to receive 2 of 3 treatments (1-week interval). They interpretated that propofol decreased mean arterial blood pressure and systemic vascular resistance immediately after induction of anaesthesia but there was no change in heart rate, cardiac output or oxygen delivery.

Khurana et al. (2014) conducted a study to know the electrocardiographic and hemato-biochemical effects of two balanced anesthetic protocols in dogs. All the animals were randomly divided into two groups of 10 animals each and were premedicated with injection atropine sulfate @ 0.04 mg/kg body weight (b.wt.) subcutaneously followed by injection butorphanol tartarate @ 0.2 mg/kg b.wt. intravenous (IV) and injection diazepam @ 0.5 mg/kg b.wt. IV at an interval of 10-15 minutes. Finally induction was done using injection propofol intravenously "till effect". They observed no arrhythmic changes in any of the animal pre-operatively and intra-operatively.

Cardoso et al. (2018) conducted a study to investigate the echocardiographic changes during anaesthesia induction in dogs sedated with acepromazine (0.05 mg/kg) and butorphanol (0.3 mg/kg) (AB). Twenty-four male dogs, with a mean weight of 12.40kg±3.1kg. They divided all twenty four dogs in to 4 groups (n=6). Fifteen minutes after administration of pre-anesthetic medication, anaesthesia with diazepam (0.5 mg/kg) and etomidate (1 mg/kg) (group DE); diazepam (0.5 mg/kg) and ketamine (3 mg/kg) (group CD); propofol (4 mg/kg) (group P); or ketamine (1mg/kg) and propofol (3 mg/kg) (group CP) was administered to 6 dogs in each group. Systolic blood pressure (SBP) was measured and echocardiography was performed immediately prior to the application of the sedation protocol (baseline), 15 minutes after sedation (M1), and immediately after anaesthesia induction (M2). They found no significant differences between groups.

Venkaiah (2010) conducted a clinical study on the use of thiopental and propofol as induction agents for isoflurane anaesthesia in 18 healthy dogs between 1 year to 6 years of age presented for ovariohysterectomy. All the dogs were

randomly divided into three groups comprising of six animals in each group and were uniformly premedicated. In the six dogs of group i, anaesthesia was induced by intravenous administration of thiopental sodium at the rate of 10 mg/kg body weight as a 2.5 percent solution. In dogs of group ii, propofol was used as an intravenous anaesthetic induction agent at the dose of 3 to 4 mg/kg. In the six dogs of group iii, isoflurane was used as induction agent using a face mask at 4 to 5 % concentration in oxygen. Immediately after induction, the dogs of all the three groups were intubated and anaesthesia was maintained with 1.5% to 2% inhalation of isoflurane during the entire surgical procedure. They recorded various parameters like physiological as well as electrocardiographic before induction, during anaesthesia and after recovery from anaesthesia and found that no abnormalities in the sizes of P, QRS or T waves, no changes in the cardiac axis and no arrhythmias of any kind in any dog of any of the groups.

Materials and Methods

CHAPTER-3

MATERIALS AND METHODS

The present clinical study was carried out on 12 clinical cases of adult dogs presented with musculoskeletal surgical conditions at the Teaching Veterinary Clinical Complex (TVCC), Department of Veterinary Surgery and Radiology, College of Veterinary Science and Animal Husbandry, U.P. Pt. Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go Anusandhan Sanasthan, Mathura (UP).

3.1 Design of clinical study

Over a period of six months 12 dogs of either gender scheduled for orthopaedic procedures were randomly selected for the study. The two anaesthetic protocols (group A and group B) as detailed below were followed in such a way that both the protocols had six replicates in each group. All the dogs were uniformly premedicated with glycopyrrolate, butorphanol and midazolam respectively before induction of anaesthesia, thus based on the induction agent used two groups of six dogs in each group was made.

3.2 Anaesthetic induction protocol

All the dogs included in the study requiring general anaesthesia were randomly assigned to group-A or group-B (n=6) as given below:

Groups (n=6)	Induction Agent	Maintenance
Group - A	Thiopental sodium	Isoflurane (1.5-2%)
Group - B	Propofol	Isoflurane (1.5-2%)

3.3 Premedication and pre-anaesthetic preparation

Prior to induction of anaesthesia solid food was withheld for maximum six hours. Pre-surgical preparation consisted of putting a 22 bwg intravenous canula into the cephalic vein and securing it appropriately with adhesive tape. It was used for pre-surgical antibiotic administration and connected to slow speed ringer's lactate infusion. All the animals were uniformly premedicated with glycopyrrolate @ 0.01

mg/kg, butorphanol @ 0.2 mg/kg and midazolam @ 0.2 mg/kg body weight intramuscularly at an interval of 10-15 minutes each.

- Glycopyrrolate - Gpyrolon (0.2 mg/ml), Celon Laboratories Pvt Ltd. Medchal, Dist.-500090, Telangana, India.
- Butorphanol - Butrum (1mg/ml), Aristo Pharmaceutical Pvt. Ltd. Raisen, Dist. -462046 (M.P)
- Midazolam- Midapic (1mg/ml), Rusan Pharma Ltd. Dehradun, Dist.- 248197, Uttarakhand.
- Thiopental-Thiosol (500mg), Neon Laboratories Ltd. Andheri, Dist-400093, Mumbai.
- Propofol - Troypofol (10mg/ml), Neon Laboratories Ltd. Bolsar Road, Palghar, (Thane), M.S.
- Isoflurane – Sosrane, Neon Laboratories Ltd. Bolsar Road, Palghar (Thane), M.S.

3.4 Induction

Group A

Thiopental solution of 2.5% was prepared by dissolving its 500 mg in 20 ml pyrogen free sterile distilled water for making 25 mg/ml solution. Volume based on 10mg/kg maximum dose was taken in a sterile syringe and induction of anaesthesia was achieved by slow intravenous administration of thiopental sodium “till effect” i.e. abolition of pedal and laryngeal reflex keeping the upper dose limit as 10 mg/kg body weight.

Group B

In group B, propofol (sterile, nonpyrogenic emulsion containing 10 mg/ml propofol) was used. Volume based on 4 mg/kg maximum dose on the basis of the body weight of the dog was taken in a sterile syringe. Induction of anaesthesia was achieved by slow intravenous administration of propofol “till effect” i.e. abolition of pedal and laryngeal reflex keeping the upper dose limit as 4 mg/kg body weight.

3.5 Maintenance of Anaesthesia

Immediately after the achievement of desirable induction anaesthesia in both the groups, endotracheal intubation was performed using a cuffed, correctly sized,

polyvinyl chloride endotracheal tube. The distal end of the ET tube was lubricated with minimum lidocaine gel. The dog was restrained in sternal recumbency with the head and neck extended, holding the upper jaw open with a long piece of roll gauze, and pulling the tongue forward and down out of mouth. The endotracheal tube was inserted gently into the trachea with the help of laryngoscope. The cuff was inflated and endotracheal (ET) tube was secured with animal's upper jaw with the help of cotton tape. The ET tube was gently attached to the anaesthesia machine. The vaporizer setting for isoflurane (1.5-2%) during maintenance anaesthesia was adjusted to achieve an appropriate anaesthetic plane for surgery determined by the patients eyeball position, muscle tone, palpebral reflex, pupil aperture and cornea moisture. Ringer's lactate solution was administered perioperatively for the duration of the anaesthesia.

Details of anaesthetic protocol of different groups of animals studied are given as:

Table No.1: The anaesthetic protocols used in the present study;

Groups	Pre-anaesthetic agents	Induction Agent	Maintenance Agent
Group - A (n=6)	Glycopyrrolate (0.01mg/kg, i/m) Butorphanol (0.2 mg/kg, i/m) Midazolam (0.25 mg/kg, i/m)	Thiopental sodium (10 mg/kg) I/V	Isoflurane (1.5-2%)
Group - B (n=6)		Propofol (4 mg/kg) I/V	Isoflurane (1.5-2%)

The observations were first recorded as pre-anaesthetic value (PA). This was followed by pre-anaesthetic administration and then induction agents were administered. After induction (AI) observations were recorded on attaining anaesthetic level permitting endotracheal intubation and transferring the dog to inhalation anaesthesia machine on inhalant gas mixture. Peak anaesthesia (PE) observations were made at the time of conclusion of the procedures immediately before the volatile anaesthetic administration was stopped. On return of swallowing reflex, endotracheal tube was removed. AR, time was identified as the time when the dogs attained sternal recumbency and was able to maintain normal carriage of its head and neck.

3.6 Collection of Blood Sample

Prior to pre-anaesthetic administration, estimation of haemoglobin was done by taking one ml of blood from the cephalic vein in Ethylene diamine tetra-acetic acid (EDTA) vial and 0.5 ml was also taken in heparinized syringe for analysis of venous blood gas parameters. Mean while 0.5 ml of blood was also collected from femoral/dorsal pedal artery for arterial blood gas analysis. In continuation of this, blood samples were collected at, after induction, peak effect of anaesthesia and at recovery consequently during the whole surgical procedure for analysis of blood gas parameters using HDC-Lyte Plus ABGE Reagent Pack Machine.

3.7 Observations

All the observations were recorded at base line before pre-anaesthetic medication (PA), after induction (AI) and peak effect (PE) of anaesthesia, and at recovery from anaesthesia (AR).

3.7.1 Physiological

The physiological parameters recorded were, rectal temperature (^{0}F) by using digital thermometer, respiratory rate (breaths/minute) by observing thoracic excursions and movement of reservoir bag during surgical anaesthesia and heart rate/pulse rate (beats/minute) by auscultation/multiple parameter monitor device.

3.7.2 Blood gas parameters

The blood (0.5ml) from femoral/dorsal pedal artery and cephalic/saphenous vein was collected for the evaluation of arterial and venous blood gas parameters using HDC-Lyte Plus ABGE Reagent Pack machine and the appropriate pressure for about 1minute was continuously applied over the site to prevent hematoma formation.

3.7.3 Cardiovascular parameters

Blood pressure (mm Hg) was recorded by applying the appropriate size bp cuff above the hock joint and pulsation of the dorsal pedal artery was recorded by using Blood flow Doppler Model BF2 machine. 2nd lead electrocardiography was recorded after applying all the four (red- right forelimb, behind the elbow joint, yellow- left forelimb, behind the elbow joint, black- right hind limb, at front of stifle joint and green- left hind limb, at front of stifle joint) leads using BPL, Cardiart

6108T and oxygen saturation of haemoglobin (%) was recorded and observed using multiple parameter monitor device Excello model.

3.8 Statistical Analysis

The recorded data for various parameters were subjected to statistical analyses for interpretation of results. The data was subjected to a critical difference independence t-test for the comparison of mean values. A probability level of $P<0.05$ was considered as statistically significant. The mean values and mean standard deviation (SD) were recorded and presented in tabular form.

Results

CHAPTER -4

RESULTS

Comparative evaluation of thiopental and propofol as induction agents in dogs was done in 12 clinical cases in two groups of 6 dogs in each as mentioned in the previous chapter. In group-A thiopental was used as anaesthesia induction agent whereas, in group-B the induction agent was propofol.

Comparison of both anaesthetic induction agents was done on the basis of observations recorded for the changes in physiological, blood gas and cardiovascular parameters at different intervals.

Pre-anaesthetic medications with glycopyrrolate-butorphanol-midazolam-remained same in both the groups and in both the groups similar surgical procedures were performed involving musculo-skeletal conditions.

In group-A clinical cases of dogs thiopental sodium and in group-B propofol was administered intravenously as anaesthesia induction agent. Successful induction was marked with abolition of pedal and laryngeal reflex. In five dogs of total six in group-A, induction was achieved at 8 mg/kg bolus dose of 2.5 percent thiopental sodium intravenously, whereas in one dog a dose of 10 mg/kg was needed for abolition of reflexes permitting endotracheal intubation.

Similarly, in group-B surgical anaesthesia could be induced at 3.5 mg/kg dose of propofol administered slowly intravenously in 5 dogs whereas, in one dog a total volume based on 4 mg/kg dose rate in the syringe had to be administered for attaining the anaesthesia level adequate for permitting intubation.

Immediately consequent to inductions and endotracheal intubation, the ET tube was connected to anaesthesia machine and eventless anaesthesia was maintained for the needful duration of the surgery using 1.5-2% isoflurane-oxygen inhalant gas mix. Flow rate was maintained at 30-50 ml/kg/min.

4.1 Observations

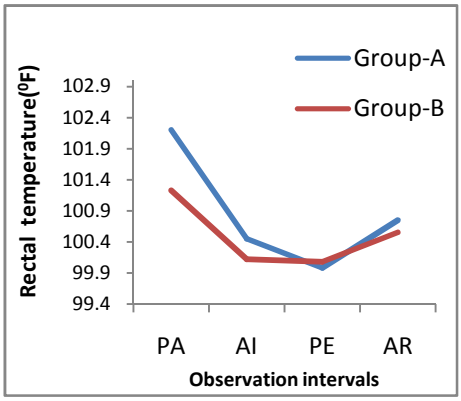
Physiological parameters (Rectal temperature, Respiration rate and Pulse rate) were recorded as before pre-anaesthetic administration (PA), after induction (AI), at peak effect of anaesthesia (AP) and after recovery (AR) in both the groups.

4.1.1 Rectal temperature

Mean rectal temperature at AI, PE and AR showed a decrease in both the groups in comparison to its base value at PA, however, as the graphs shows, in group-B, rising trend started occurring earlier than in group-A. Between the groups, the mean values differed significantly ($p<0.05$) except at peak anaesthesia level. The group and interval wise mean rectal temperature and its graphic representation is given in table-1.

Table & Fig. 1: Mean ± S.D of Rectal temperature (^{0}F) in dogs anaesthetized with Thiopental and Isoflurane (Group-A; n=6); Propofol and Isoflurane (Group-B; n=6).

Gr.	PA	AI	PE	AR
A	102.2 ±0.22	100.45 ±0.61	99.98 ±0.51	100.75 ±1.26
B	101.23 ±1.10	100.12 ±0.28	100.08 ±0.82	100.55 ±0.53
P	p<0.05	p<0.05	p≥0.05	p<0.05

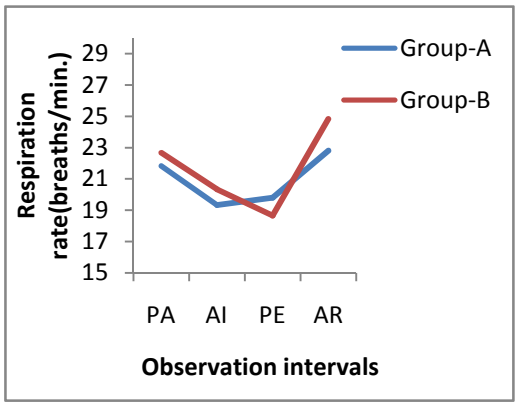


4.1.2Respiration rate

Mean respiration rate at AI, PE showed a 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 more than the mean value at PA in respective groups. Between the groups, the mean values at various intervals did not differ significantly ($p\geq0.05$). The group and interval wise mean respiration rate and its graphic representation is given in table-2.

Table & Fig. 2: Mean ± S.D of Respiration rate (breaths/min.) in dogs anaesthetized with Thiopental and Isoflurane (Group-A; n=6); Propofol and Isoflurane (Group-B; n=6).

Gr.	PA	AI	PE	AR
A	21.83 ±2.56	19.33 ±3.26	19.8 ±1.16	22.8 ±1.47
B	22.66 ±1.96	20.33 ±1.63	18.66 ±1.86	24.83 ±2.04
P	p≥0.05			

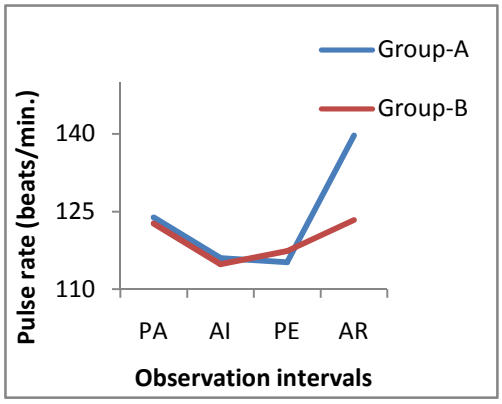


4.1.3 Pulse rate

Mean pulse rate at AI, PE showed a decrease in both the groups in comparison to its base value at PA, however, beyond PE, its showed a rising trend and at AR and its mean value was more than the mean value at PA in group-A. In group-B, a gradual rise occurred after AI and at AR, the mean value became almost similar to base value. Between the groups, the mean values at various intervals did not differ significantly (p≥0.05) except at peak anaesthesia level. The group and interval wise mean Pulse rate and its graphical representation is given in table-3.

Table & Fig. 3: Mean ± S.D of Pulse rate (beats/min.) in dogs anaesthetized with Thiopental and Isoflurane (Group-A; n=6); Propofol and Isoflurane (Group-B; n=6).

Gr.	PA	AI	PE	AR
A	123.83 ±4.66	116.00 ±4.42	115.17 ±6.55	139.67 ±15.83
B	122.67 ±5.92	114.83 ±6.64	117.33 ±3.01	123.33 ±2.94
P	p≥0.05		p<0.05	p≥0.05



4.2 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.

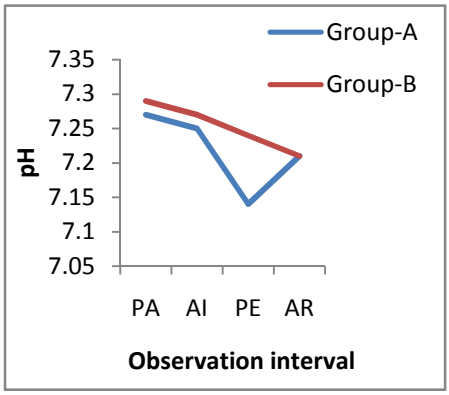
4.2.1 Arterial blood gas variations

4.2.1.1 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 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-4.

Table & Fig. 4: Mean ± 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 ±0.02	7.25 ±0.04	7.14 ±0.05	7.21 ±0.06
B	7.29 ±0.04	7.27 ±0.03	7.24 ±0.03	7.21 ±0.01
P	($p \geq 0.05$)		$p < 0.05$	($p \geq 0.05$)

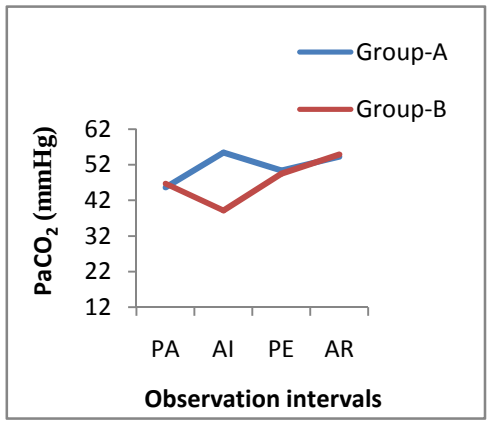


4.2.1.2 Partial pressure of carbon dioxide ($PaCO_2$)

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-5.

Table & Fig.5: Mean ± 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 ±2.83	55.47 ±6.25	50.38 ±1.50	54.28 ±1.95
B	46.71 ±7.59	39.13 ±6.86	49.54 ±3.64	54.88 ±3.98
P	p≥0.05			

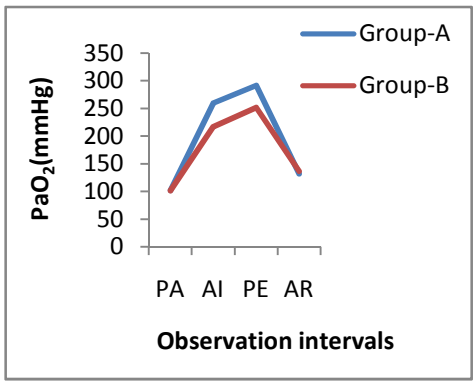


4.2.1.3 Partial pressure of oxygen (PaO_2)

Mean partial pressure of oxygen at AI, PE showed a 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≥0.05). The group and interval wise mean partial pressure of oxygen and its graphical representation is given in table-6.

Table & Fig. 6: Mean ± 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 ±3.39	259.67 ±8.53	291.61 ±9.27	132.19 ±9.57
B	101.52 ±10.66	217 ±83.13	251.64 ±90.39	136.74 ±5.35
P	p≥0.05			

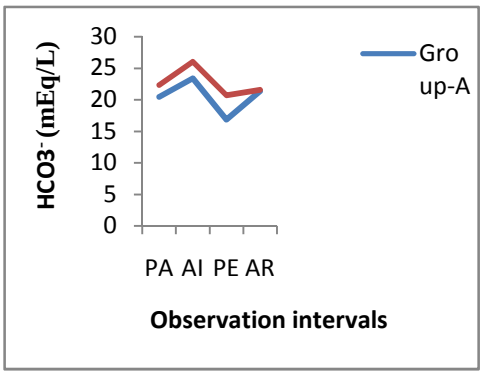


4.2.1.4 Bicarbonate (HCO_3^-)

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-7.

Table & Fig. 7: Mean ± 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 ±2.32	23.40 ±0.08	16.83 ±2.28	21.36 ±2.35
B	22.30 ±5.71	26.00 ±1.79	20.70 ±1.64	21.56 ±2.16
P	p≥0.05	p<0.05		p≥0.05



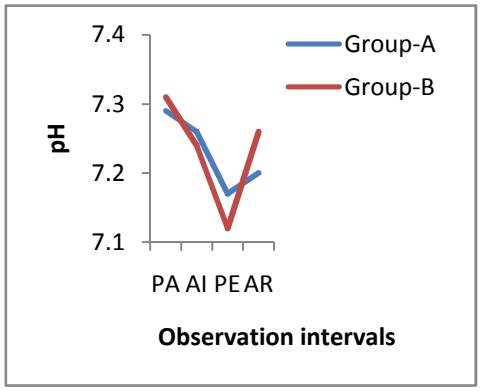
4.2.2 Venous blood variations

4.2.2.1 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-8.

Table & Fig. 8: Mean ± 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 ±0.01	7.26 ±0.02	7.17 ±0.02	7.20 ±0.01
B	7.31 ±0.02	7.24 ±0.04	7.12 ±0.06	7.26 ±0.02
P	p≥0.05			p<0.05

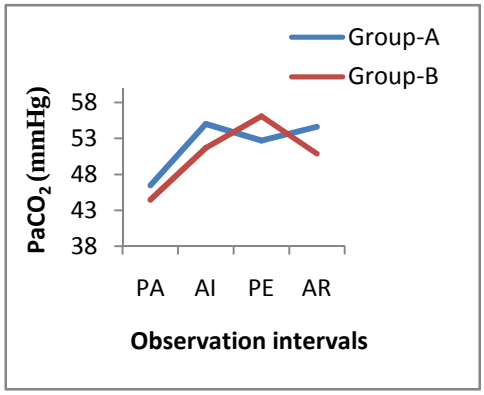


4.2.2.2 Partial pressure of carbon dioxide ($PaCO_2$)

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≥0.05). The group and interval wise mean partial pressure of carbon dioxide and its graphical representation is given in table-9.

Table & Fig. 9: Mean ± 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 ±4.42	55.00 ±7.13	52.69 ±8.59	54.63 ±3.27
B	44.46 ±2.70	51.66 ±5.10	56.07 ±4.96	50.86 ±8.04
P	p≥0.05			

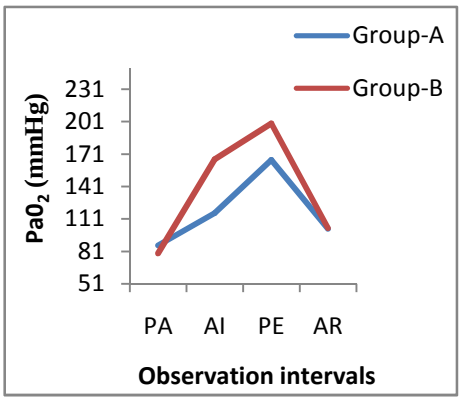


4.2.2.3 Partial pressure of oxygen (PaO_2)

Mean partial pressure of oxygen at AI, PE showed a 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 ($p \geq 0.05$) except at AI and PE. The group and interval wise mean partial pressure of oxygen and its graphical representation is given in table-10.

Table & Fig. 10: Mean ± 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 ±5.45	116.31 ±32.61	165.43 ±15.86	101.89 ±11.71
B	79.17 ±7.15	166.13 ±8.66	199.15 ±11.01	102.46 ±6.39
P	$p \geq 0.05$	$p < 0.05$		$p \geq 0.05$

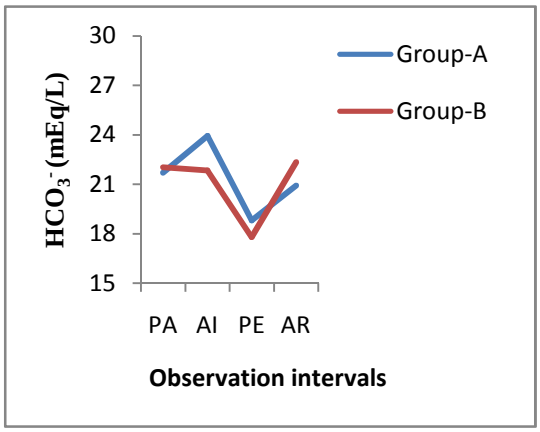


4.2.2.4 Bicarbonate (HCO_3^-)

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-11.

Table & Fig. 11: Mean ± 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 ±2.90	23.93 ±3.53	18.8 ±2.64	20.93 ±0.85
B	22.03 ±2.26	21.83 ±4.56	17.8 ±2.38	22.34 ±4.12
P	p≥0.05			



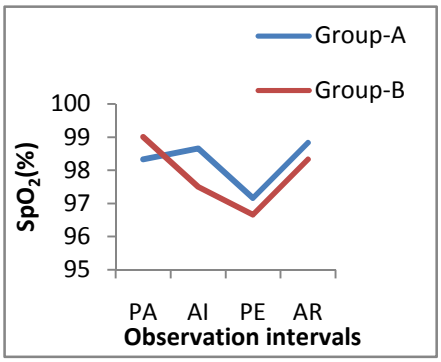
4.3 Cardiovascular parameters

4.3.1 Oxygen saturation of haemoglobin (%)

Mean Oxygen saturation of haemoglobin (SpO_2) at AI, showed an increase then decrease at PE in group-A. 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≥0.05). The group and interval wise mean Oxygen saturation of haemoglobin and its graphical representation is given in table-12.

Table & Fig. 12: Mean ± S.D of Oxygen saturation of haemoglobin (%) in dogs anaesthetized with Thiopental and Isoflurane (Group-A; n=6); Propofol and Isoflurane (Group-B; n=6).

Gr.	PA	AI	PE	AR
A	98.33 ±0.51	98.66 ±1.03	97.16 ±0.75	98.83 ±0.75
B	99.00 ±0.89	97.5 ±0.83	96.66 ±0.51	98.33 ±1.03
P	p≥0.05			

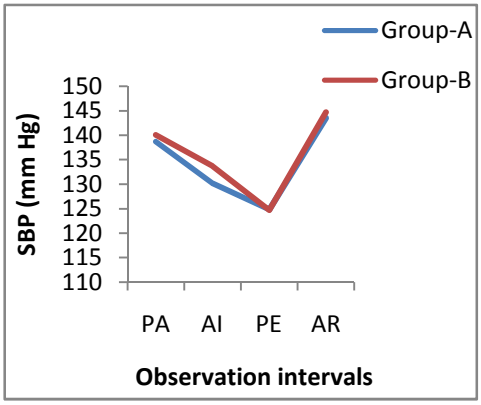


4.3.2 Systolic blood pressure (mm Hg)

Mean systolic blood pressure at AI, PE showed a 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 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 systolic blood pressure and its graphical representation is given in table-13.

Table & Fig. 13: Mean ± S.D of Systolic blood pressure (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	138.67 ±4.71	130.17 ±5.63	124.83 ±5.19	143.50 ±6.15
B	140.00 ±4.97	133.67 ±5.81	124.67 ±7.86	144.67 ±4.54
P	p≥0.05			



4.3.3 Electrocardiography

Electrocardiographic studies in the dogs of both groups revealed no abnormalities in the sizes of P wave, QRS complex or T waves. No arrhythmias of any kind were recorded in any animals of any group. Representative ECG recordings obtained before pre-anaesthetic, after induction, at peak effect and at recovery for each of the two groups have been presented in fig.14-21.

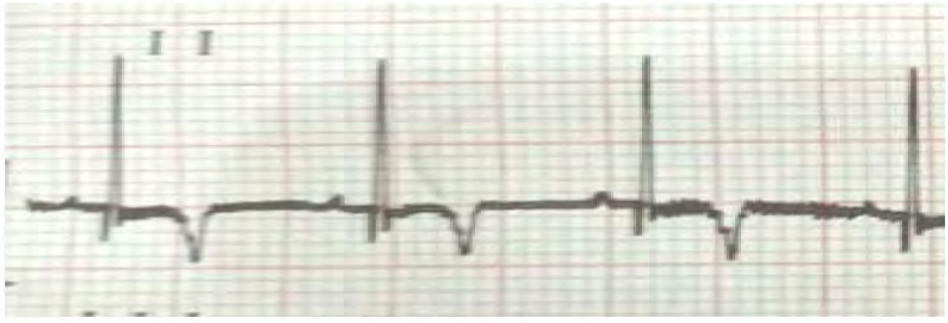


Fig. 14: ECG before pre-anaesthetic administration

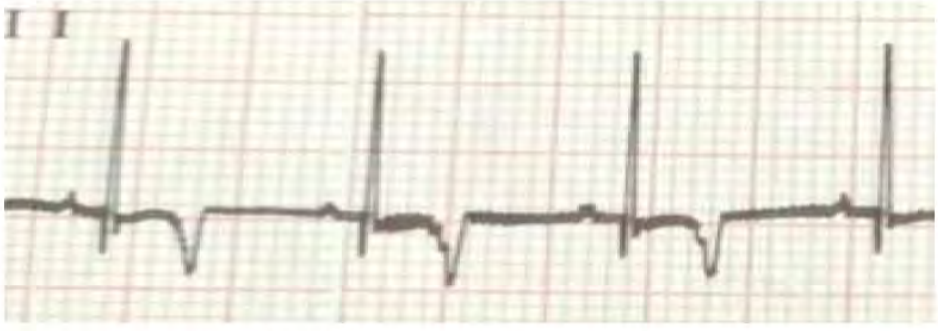


Fig. 15: ECG after induction of thiopental

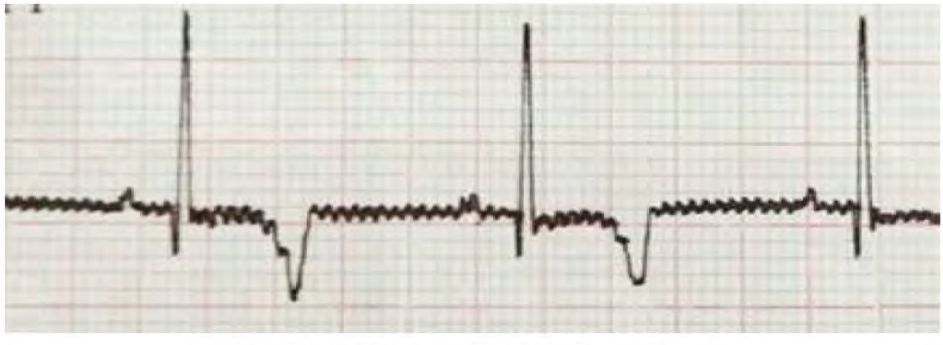


Fig. 16: ECG at peak anaesthesia level

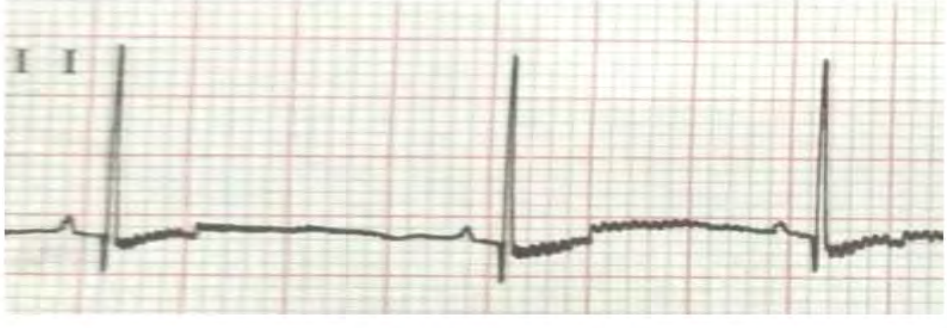


Fig. 17: ECG after recovery from anaesthesia

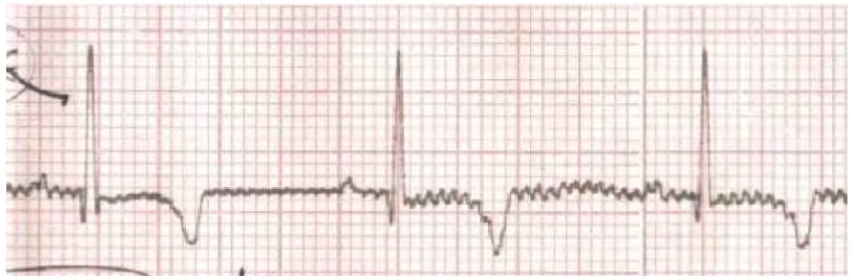


Fig. 18: ECG before pre-anaesthetic administration

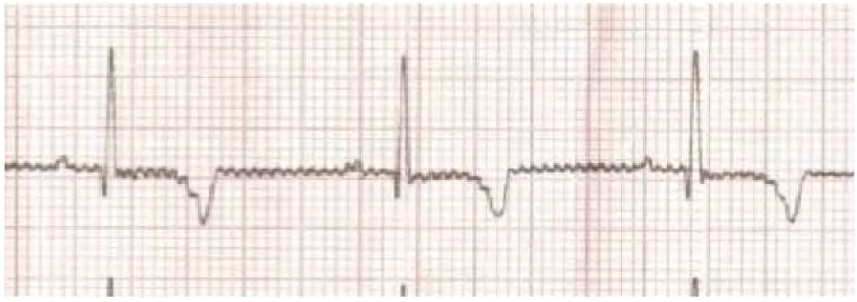


Fig.19: ECG after induction of propofol

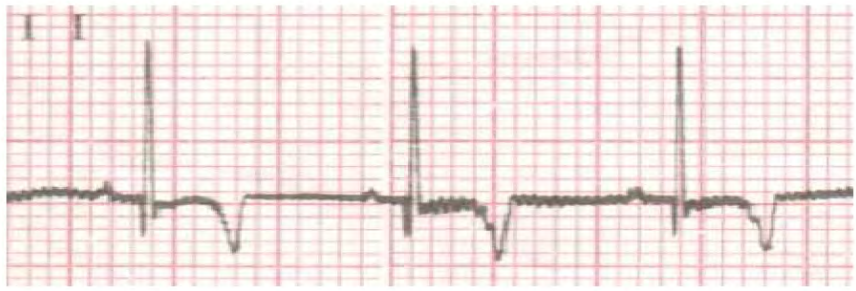


Fig. 20: ECG at peak anesthesia level

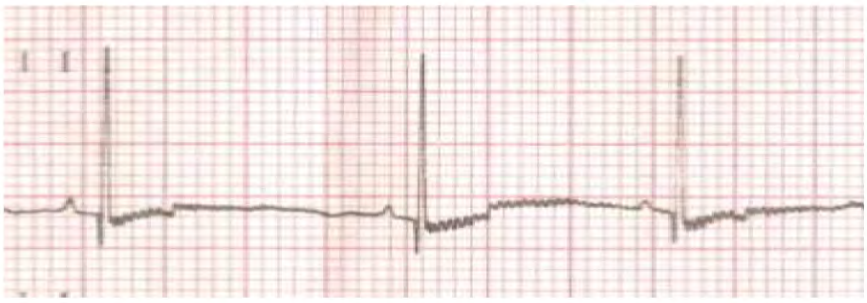


Fig. 21: ECG after recovery from anaesthesia

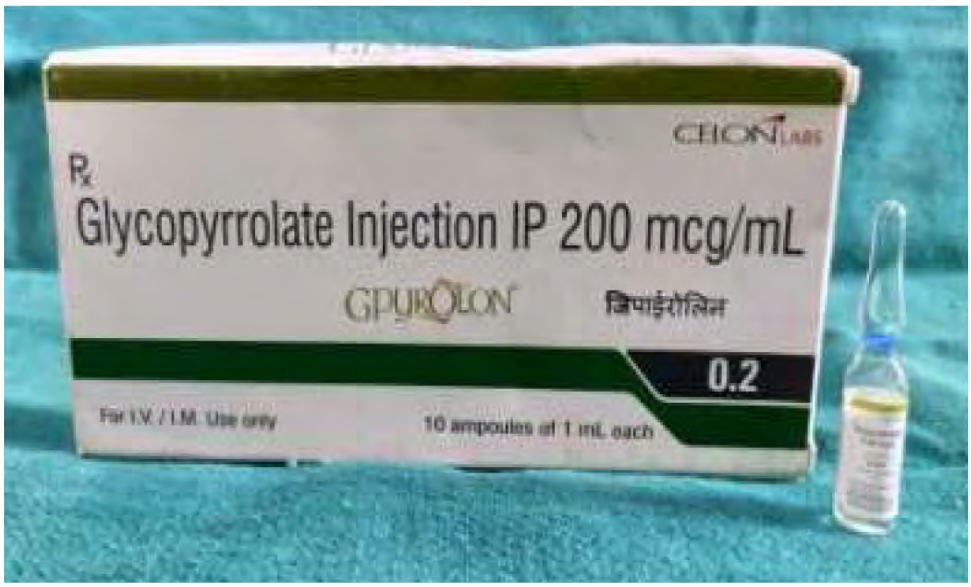


Fig. 22: Gpyrolon (Glycopyrrolate)

Fig. 23: Butrum (Butorphanol)

Fig. 24: Midapic (Midazolam)

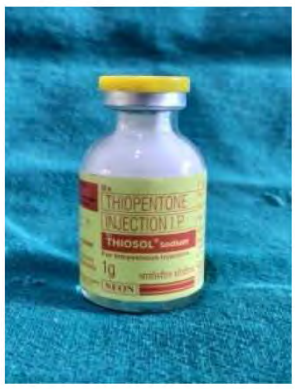


Fig. 25: Thiosol (Thiopental Sodium)

Fig. 26: Troypofol (Propofol)

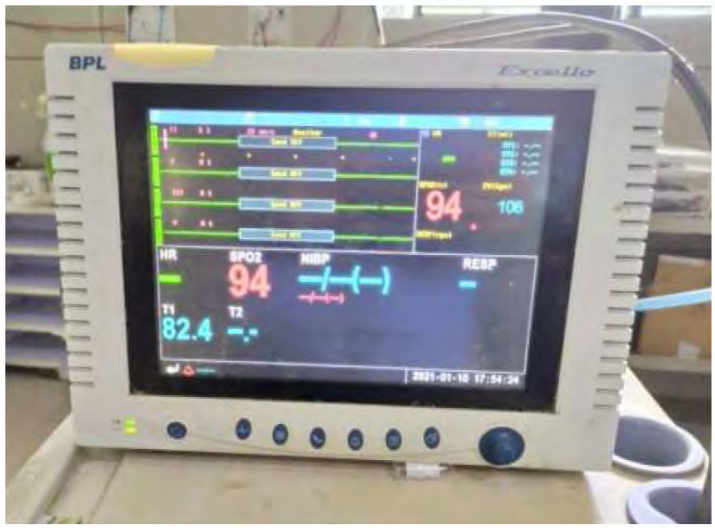


Fig. 27: Multiple parameter monitor (Excello model)

Fig. 28: SBP machine (Blood flow doppler model BF2)

Fig. 29: ECG machine (BPL Cardiart 6108T)

Fig. 30: HDC-LYTE ABG machine.

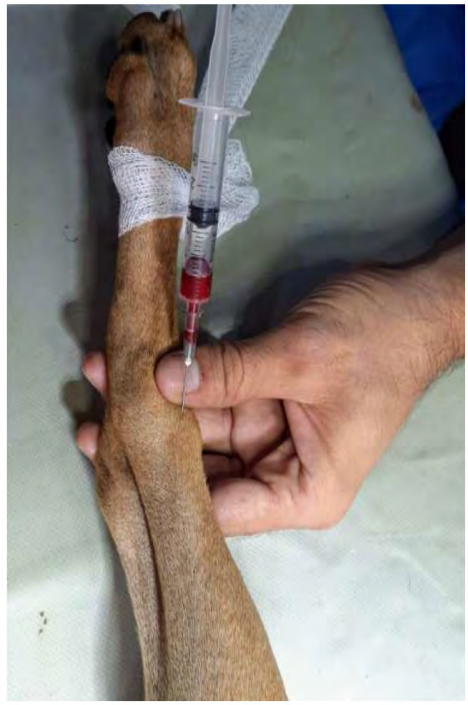


Fig. 31: Dorsal pedal artery (ABG)

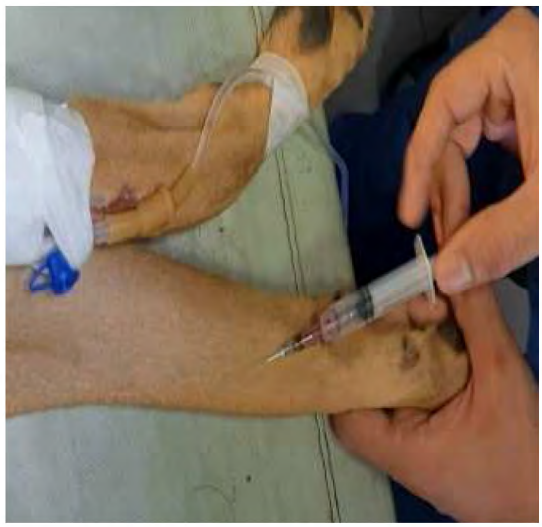


Fig. 32: Cephalic vein (VBG)

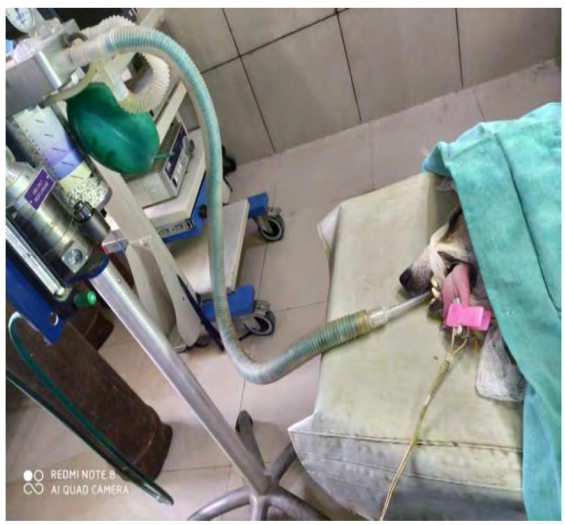


Fig. 33: Maintainance anaesthesia (Isoflurane 1.5-2.0%)

Discussion

CHAPTER-5

DISCUSSION

Considering the size of the dogs included in the present study having one or other musculoskeletal condition and the fact that except for the conditions mentioned, the dogs were healthy subjects, a fasting period of only upto six hours prior to anaesthesia proved adequate. During induction regurgitation did not occur in any case. Fasting the healthy dogs six hours prior to anaesthesia is a gold standard practice recommended in the literature (Bednarski, 2007).

Anticholinergic drugs are recommended for the treatment of vagally-induced bradycardia during anaesthesia, and occasionally suggested for prevention of its occurrence, if a profound opioid analgesic is used (Thurmon et al., 1996). Glycopyrrolate, a synthetic quaternary ammonium antimuscarinic agent has received attention of anesthetists in veterinary medicine (Riviere & Papich, 2009). It has distinct advantage over classical pre-anaesthetic anticholinergic agent atropine due to its inability to cross the blood brain barrier, hence in the pre-anaesthetic medication in the present work Glycopyrrolate followed by Midazolam was used @ 0.01mg/kg & 0.2 mg/kg body weight intramuscularly respectively, following Doering et al. (2016) and Schwartz et al. (2013). Glycopyrrolate is known to be advantageous over atropine as it causes little or no effect on CNS function, pupil diameter and intraocular pressure but is capable of preventing vagal reflex (Bednarski, 2007).

Midazolam is a benzodiazepine tranquilizer offering advantages of diazepam for musculo relaxation without having the disadvantage of being an irritant when given intramuscularly and is very well absorbed when administered by this route. It is water soluble, but once absorbed its chemical configuration changes and it becomes lipid soluble (Lemke, 2007). Midazolam is readily distinguished from other benzodiazepines because of its rapid onset and short duration of action, low incidence of thrombophlebitis, pain on site of injection and minimal cardiovascular and respiratory effects. The physicochemical properties of midazolam allow for enhanced water solubility, which limits physicochemical incompatibilities (Fragen et al., 1997). Onset of sedative action and muscular relaxation after intramuscular administration of Midazolam occurred rapidly as it also reported in the literature studied, hence included in pre-anaesthetic medication in the present work.

Butorphanol was included as a pre-anaesthetic due to its cardiopulmonary sparing effect and the quality sedation and analgesia when used concurrently with midazolam. It is a sympathetic agonist-antagonist opioid and is not to be considered as mono-analgesic in dogs (Pallasch et al., 1985; Lamont and Mathew, 2007). Butorphanol was used with the dose rate of 0.2 mg/kg intramuscularly (Tamura et al., 2016). Butorphanol is rapidly absorbed after parenteral administration and has a distribution half-life of 5 minutes (Ferrante et al., 1993).

Thiopental/Thiopental sodium belongs to ultra short acting class of barbiturates with a narrow safety margin and has been a popular intravenous general anaesthetic since many decades. However, the ultra short acting barbiturates produce a defined but a very short duration of anaesthesia. The depth of anaesthesia produced depends upon its concentration in blood and brain tissue (Ilkiw et al., 1991). It is used to induce and maintain sleep; complete anaesthesia (amnesia, analgesia and reflex suppression) may be provided by the anaesthetic gases (Breivik et al., 1978; Turcant et al., 1985). Thiobarbiturates are recommended as sole anesthetic or for induction prior to inhalation in 1.25-5% concentration @ dose rate of 10-30 mg/kg body weight intravenously. When induction is preceded by pre-anaesthetic sedation a dose of 8-15 mg/kg body weight is recommended (Branson, 2007). In glycopyrrolate-butorphanol-midazolam premedicated dogs in the present work the dose required for induction of anaesthesia and intubation was less than 10 mg/kg and this is in agreement with the recommendations.

Propofol is an intravenous anaesthetic which is used during the surgical procedures for maintaining sedation, during monitored anaesthesia care as well as an induction agent for general anaesthesia. It may be administered intravenously as a bolus or an infusion or some combination of the two (Smithburge et al., 2019; Zhang et al., 2019; Heim et al., 2019). It has been used as an intravenous hypnotic sedative drug for induction and maintenance of sedation and general anaesthesia (Sahinovic et al., 2018). It exerts CNS depression by enhancing the effect of GABA and decreasing brain metabolic activities. It is also known to cause hypotension but is not arrhythmogenic and is used in non-premedicated and premedicated dogs @ dose rate of 6-8 mg/kg and 2-4 mg/kg body weight intramuscularly respectively for induction of anaesthesia (Branson, 2007). In the present work in glycopyrrolate-butorphanol-midazolam premedicated dogs the dose required for induction of anaesthesia

permitting intubation was less than 4 mg/kg and this is in agreement with the recommendations.

Inhalant volatile anaesthetics are known to reduce cerebral metabolic rate, depress respiration, variably affect the pain threshold, causes direct myocardial depression and a decrease in sympathoadrenal activity (Steffey and Mama, 2007). Isoflurane a volatile inhalant anaesthetic, is currently most favored agent in veterinary medicine, although after its used vasodilation is reported to increase with increase in depth of anaesthesia contributing to hypotension but its myocardial depressant effect is far less than halothane (Seahorn, 2001). In the present work, isoflurane was used at 1.5-2.0 percent vaporizer setting for maintenance of general anaesthesia throughout the required duration of the procedure with the flow rate of 30-50 ml/kg/min (Dunlop C, 2014). In the literature reviewed, isoflurane is recommended for maintenance of anaesthesia at 1.5 to 2.5 percent (Bednarski, 2007) and the concentration employed in the present work was found adequate and within the recommended limit.

The observations were first recorded as pre-anaesthetic value (PA). This was followed by pre-anaesthetic administration and then induction agents were administered. After induction (AI) observations were recorded on attaining anaesthetic level permitting endotracheal intubation and transferring the dog to inhalation anaesthesia machine on inhalant gas mixture. Peak anaesthesia (PE) observations were made at the time of conclusion of the procedures immediately before the volatile anaesthetic administration was stopped. On return of swallowing reflex, endotracheal tube was removed. AR, time was identified as the time when the dogs attained sternal recumbency and was able to maintain normal carriage of its head and neck.

5.1 Physiological parameters

General anaesthetic being CNS depressant are known to cause a variable degree of decrease in body temperature, heart rate and respiration rate irrespective of the agent being used . The premedicants leading to pre-anaesthetic sedation also contribute in this respect.

In the present study in both the groups a decrease in physiological parameters i.e rectal temperature, respiration rate and heart rate was recorded following administration of induction agents as can be seen from the table and graph 1-3. Thiopental was found to depress respiration rate to a greater duration than propofol.

Similar findings showing thiopental to be more potent respiratory depressant than propofol have also been reported (Choi et al., 2016; Joubert and Lobetti, 2002). Decrease in rectal temperature following anaesthesia using various agents including propofol and thiopental has been amply documented (Mohammad et al., 2009; Jena et al., 2014; Choi et al., 2016; Chandrakal et al., 2017). During anaesthesia decrease in body temperature is known to occur due to decrease in basal metabolic rate (Manat, 2001). It is to be noted that in both the groups in the present work normalization of all three physiological parameter occurred after removal of endotracheal tube at recovery from anaesthesia. The respiratory rate and pulse rate registered an increase over their base value, whereas rectal temperature remained low in comparison to its base value although the fluctuations were within normal range for the species. Contrary to the present finding, an increase in mean heart rate was recorded by (Manat, 2001; white, 2001). However (Dennis et al., 2007) recorded an increase in heart rate in thiopental and propofol induction. In the present study at peak anaesthesia level heart rate differed significantly between the groups, but they were within normal range.

5.2 Blood gas variations

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) with the decrease in pH after induction with thiopental and propofol and also by Fukushima et al. (2011) who observed a decrease in blood pH at various time intervals after using propofol as an induction agent and isoflurane as a maintainance 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 of Gonclaves et al. (2009) 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 $PaCO_2$ 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 Laythm al-kattan (2013). Contrary to this an increase in post induction $PaCO_2$ was found in case of propofol (Maney et al., 2013; Sams et al., 2008). On comparison between the groups, the difference was non-significant. Similar

findings were observed by Gonclaves et al. (2009) with the no significant difference in blood gas variables in propofol anaesthesia in dogs.

Mean PaO_2 values showed a rising trend immediately after induction in both the groups which was supported by the findings of Laythm al-kattan (2013), However after administration of isoflurane both the groups showed a greater increase in mean PaO_2 value compared to the base line values. Similar findings were reported by Enouri et al. (2008) and Laythm al-kattan (2013), 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).

The mean values of HCO_3 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 HCO_3 in case of propofol anaesthesia in dogs was observed by Maney et al. (2013) and Sams et al. (2008). However, Enouri et al. (2008) 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) and Gonclaves et al. (2009). 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 PaO_2 was seen between ABG and VBG samples of the same interval, gross dissimilarity was there in mean $PaCO_2$ and HCO_3 values of ABG and VBG samples making this an unreliable method. In the perused literature, however, it is reported that the pH and $PaCO_2$ provide clinically acceptable substitute of ABG samples in the dog population study (Pang et al. 2009).

5.3 Cardiovascular parameters

In this study the oxygen saturation of haemoglobin (SpO_2) started decreasing since administration of pre-anaesthetic till peak level in group A while it showed an

increase initially and decrease thereafter till peak effect in group B. An increase over the PE value was occurred at AR or after recovery, which is graphically represented and tabulated in Table & Fig 12, although fluctuations in SpO_2 were within normal range and no significant difference was between the groups. Similar findings were noted down by Hofmeister et al. (2008) and Gonclaves et al. (2009). Contrary to this Manat (2001) reported a non-significant ($p \geq 0.05$) decrease in oxygen saturation in all the animals having induction with propofol.

In the present work systolic blood pressure in both the groups decreased after induction and was lowest at peak anaesthesia level but normalized at recovery. Between the groups there was no significant difference observed. Similar findings have been reported by Choi et al. (2016) in monkeys who observed significantly lower SBP after thiopental as compared to propofol induction. White et al. (2001) found no change on SBP in diazepam-ketamine-thiopental anaesthesia in dogs and Hofmeister et al. (2008) also observed no significant change in cardiovascular parameters under propofol and thiopental anaesthesia in dogs.

Electrocardiographic studies in the dogs of all the two groups revealed no abnormalities in the sizes of P wave, QRS complex or T waves and no rhythm disturbances were recorded in any dog of both the groups. Similarly, no abnormalities in the sizes of P wave, QRS complex or T waves, no changes in the cardiac axes and no arrhythmias of any kind occurred in dogs under thiopental or propofol induced anaesthesia maintained by isoflurane (Venkaiah, 2010) and propofol alone (Khurana et al., 2014).

On the basis of the observations on physiological, blood gas and cardiovascular changes no major deleterious effect was observed in either group A or B and the dogs made uneventful recovery in all the cases. Hence in management of musculoskeletal conditions mainly fracture management both the anaesthetic induction agents are useful. Some changes noted after induction in both the groups did not lead to major physiological maladjustment. So in fracture management both anaesthetic protocols can be considered safe in the dogs of same age group and body condition as were included in this study. Propofol, keeping in view its cost should however, be reserved for high risk old patients on the basis of its reported safety in the reviewed literature.

Summary and Conclusions

CHAPTER-6

SUMMARY AND CONCLUSIONS

The present study was conducted to evaluate the comparison of thiopental and propofol as induction agent in two groups of adult healthy dogs undergoing surgeries for musculoskeletal surgical affections, having six animals in each. Pre-anaesthetic medications, glycopyrrolate @ 0.01 mg/kg, butorphanol @ 0.2 mg/kg and midazolam @ 0.2 mg/kg were common for both the groups respectively. In group-A thiopental was used as an induction agent whereas, propofol was used as a induction agent in dogs of groups-B. Comparison of both anaesthetic induction agents was done on the basis of observations recorded for the changes in physiological, blood gas cardiovascular parameters at different intervals.

Physiological observations including, mean value of rectal temperature, respiration rate and pulse rate from 99.98-102.2, 18.66-24.83 and 114.83-139.67 in group A&B respectively. However a significant difference ($p<0.05$) was observed at PA, AI and at AR of rectal temperature and at PE of pulse rate on comparison between the groups.

Mean pH values of ABG and VBG ranged from 7.14-7.29 and from 7.12-7.31in both the groups. However the values at PE of ABG and AR of VBG showed significant difference ($p<0.05$) between the groups.

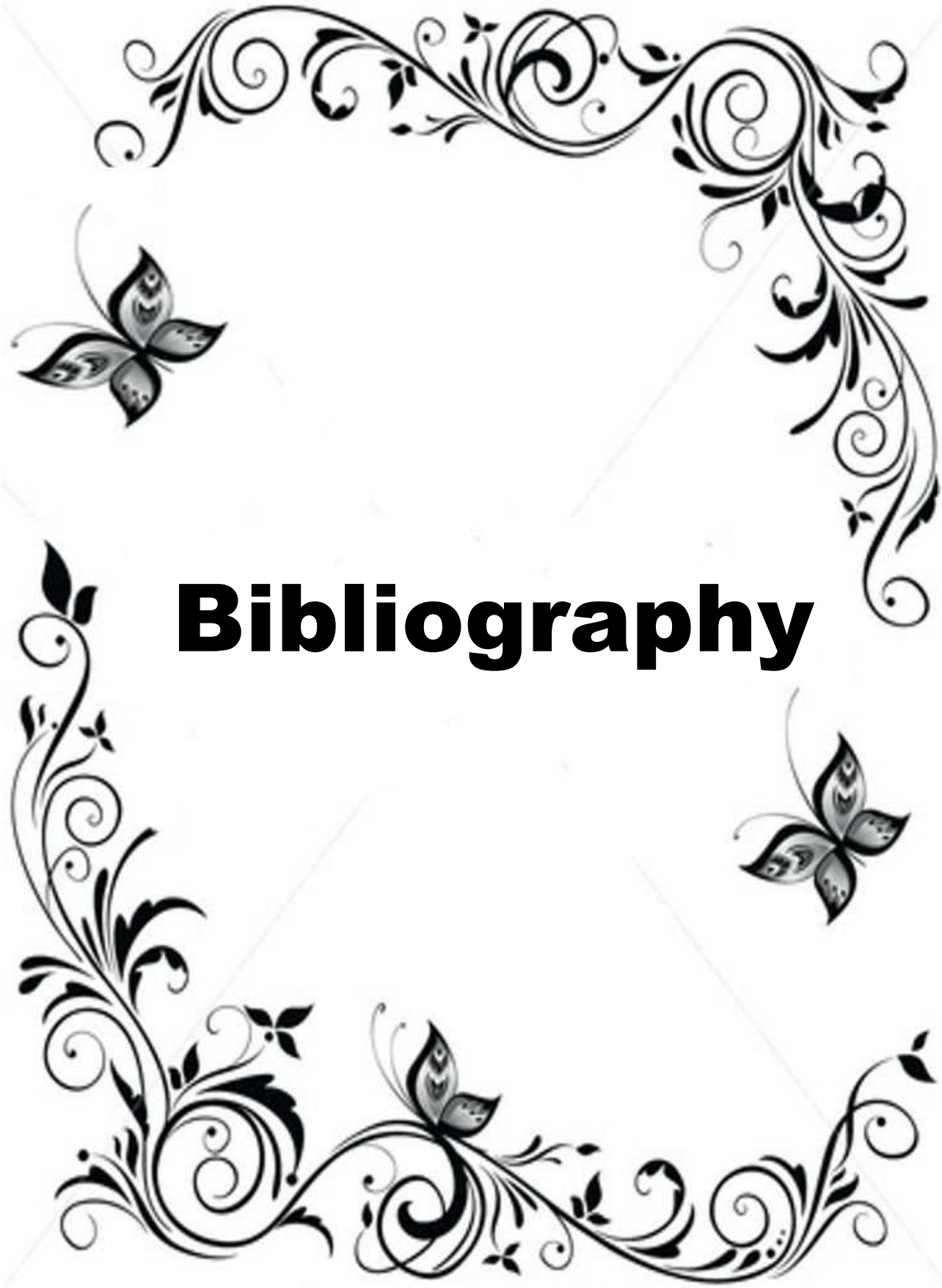
Mean $PaCO_2$ values ranged from 39.13-55.47 and from 44.46-55.0 in ABG and VBG of both the groups. However, on comparison between the groups, a non-significant difference ($p\geq0.05$) was observed.

Mean PaO_2 values of ABG and VBG in both the groups ranged from 101.52-291.61 and 79.17-199.15. However between the groups, a non-significant difference ($p\geq0.05$) was observed except at AI and PE of VBG.

Mean values of HCO_3^- in ABG and VBG of both the groups varied from 16.83-26.00 and 17.8-23.93. However, a non-significant difference ($p\geq0.05$) was observed except at AI and PE of ABG between the groups.

On comparison, mean values of, oxygen saturation of haemoglobin (SPO_2) and systolic blood pressure (SBP) resulted in a non significant ($p \geq 0.05$) change along with no abnormalities in the sizes of P wave, QRS complex or T waves and no rhythm disturbances in the electrocardiographic interpretations between the groups.

On the basis of the observations on physiological, blood gas cardiovascular changes no major deleterious effect was observed in either group A or B and the dogs made uneventful recovery in all the cases. Hence in management of musculoskeletal conditions mainly fracture management both the anaesthetic induction agents are useful. Some changes noted after induction in both the groups did not lead to major physiological maladjustment. So in fracture management both anaesthetic protocols can be considered safe in the dogs of same age group and body condition as were included in this study. Propofol, keeping in view its cost should however, be reserved for high risk old patients on the basis of its reported safety in the reviewed literature.



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ANNEXURE

S. No	Breed	Body weight (kg)	Type of Musculoskeletal affection	Duration of surgery
1	Indian Spitz	8	Tibia proximal diaphyseal fracture	55 min
2	Rottweiler	18	Femur diaphyseal fracture	50 min
3	Doberman	20	Radius and ulna mid shaft diaphyseal fracture	45 min
4	Non - Descript	16	Tibia diaphyseal fracture	45 min
5	Non- Descript	13.5	Tibia distal fracture	50 min
6	Labrador	18	Supracondylar femur fracture	50 min
7	Indian Spitz	8.5	Radius and ulna mid shaft diaphyseal fracture	35 min
8	Labrador	20	Supracondylar femur fracture	40 min
9	Labrador	20	Femur diaphyseal fracture	45 min
10	German-Shephard	19.5	Humerus diaphyseal fracture	50 min
11	Rottweiler	17.5	Tibia diaphyseal fracture	50 min
12	German Shephard	14.5	Tibia diaphyseal fracture	45 min

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High School	CBSE Board	2011	91.2%	Hindi, English, Math's, Science, Social science

Number of seminar / Conference / workshop / Training attended: 05

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List of Publications : **02**

Popular Article: **00**

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Date: 29/09/2021

Place: MATHURA

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I also undertake that patent, if any, arising out of research work conducted during the programme shall be filed by me only with due permission of the competent authority of DUVASU, Mathura (UP).

Signature of Student