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ORIGINAL RESEARCH

Effects of ketamine-xylazine and propofol-halothane anesthetic protocols on blood gases and some anesthetic parameters in dogs

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Abstract

Aim: The anesthetic effects and side effects of ketamine–xylazine and propofol–halothane at four different anesthetics protocol were examined in twenty healthy dogs.

Methods: Four treatments were conducted using five dogs in each. The first group was treated with ketamine at 15 mg/kg intramuscularly and xylazine at 5 mg/kg. The second group was treated with ketamine–xylazine same as first group, but the dogs were underwent pneumoperitoneum with CO_2. The third group was anesthetized with propofol at 2 mg/kg intravenously with inhalational halothane as maintenance anesthesia. The fourth group was treated as same as the third group but underwent pneumoperitoneum with CO_2. The behavioral changes, onset of action, induction time, the duration of surgical anesthesia, reflexes, and recovery period, blood gas changes (pH, paO_2 and $paCO_2$) were recorded pre treatment and 10 and 30 minutes period after treatment.

Results: The results showed differences in the quality of anesthesia among the four groups. The onset of anesthesia was the shortest in the third group (0.88±0.13 min). There were no significant changes in pH and $paCO_2$ determined in all the groups. No adverse reactions or complications were encountered during the anesthesia. The paO2 significantly increased 10 and 30 min after anesthesia in all group in comparison with respective pretreatment value.

Conclusion: The anesthetic protocol of propofol as induction agent with halothane as maintenance anesthesia induced a good quality anesthesia with a short duration of action and rapid smooth recovery without complications during CO_2 insufflations in dogs.

Keywords: dog, halothane, ketamine, pneumoperitoneum, propofol

Introduction

Laparoscopy is minimally an invasive technique for viewing the internal structures of the abdominal cavity. The procedure involved distention of the abdominal cavity with gas then using a rigid telescope placed through portal position into abdominal wall [1]. This procedure has an advantage. It includes relativity non invasive nature but it needs a technical skill [2]. Before performing any operation, pneumoperitonum is an essential step and it is obtained by insufflating the abdomen with carbon dioxide [3]. Blood-gas and acid-base balances give an idea about the biochemical status during pneumoperitoneum. On the other hand, pneumoperitoneum may also cause undesired effects such as transient or permanent arterial thrombosis, bleeding, hematoma, and infection [4,5]. Anesthesia is defined as a state of unconsciousness produced by a process of controlled reversible drug-induced intoxication of the central nervous system [6]. It is classified as injectable and inhalant anesthetic. Of these injectable agents, Propofol (Diprivan, ICI) is a rapid acting, non-barbiturate and relatively noncumulative IV anesthetics [6,7]. It produces satisfactory sedation with good hemodynamic stability and fast, unexcited recovery [8]. Comparing propofol hemodynamic stability with inhalant anesthetic agents, as sevoflurane propofol has less haemodynamic stability so the amount of ephedrine needed to maintain haemodynamic stability was lower during sevoflurane anaesthesia than propofol [9]. Propofol causes decreases in brain functional integration simultan-eously induce loss of consciousness [10]. It can be mixed with thiopentone with minimum signs of apnea,smooth induction and recovery [11].

Ketamine is used as intramuscular general anesthetic. It appears to provide good somatic analgesia but poor visceral analgesia. Ketamine increases muscle tone and may cause rigidity, if administered alone, so it is usually combined with drugs with good muscle relaxant properties as alfa2 adrenoceptor agonists [12]. Anesthesia during the laparoscopic procedure is more technically demanding due to the effect on ventilation and acid base balance. The technique itself introduces some trespassing on the respiratory and cardiovascular

Table-1. The anesthetic quality and parameters of four protocols in the dogs.

Groups	Onset minute	Induction minute	Swallowing reflex\minute	Pedal reflex minute	Duration of action\minute	Recovery Minute
G1	2.08±0.24 A	2.78±0.33 A	2.82±0.22 A	5.76±0.19 A	67.20±2.59 A	69.80±2.63 A
G2	2.08±0.31 A	2.36±0.33 A	2.48±0.30 A	5.24±0.26 A	68.40±2.15 A	71.00±2.28 A
G3	0.80±0.148 B	0.92±0.14 BC	1.94±0.12 C	3.70±0.19 C	58.80±0.86 C	60.40±0.92 C
G4	0.80±0.148 B	0.90±0.05 B	1.86±0.14 BA	3.18±0.30 BA	57.60±1.43 B	59.20±1.59 B

The different letters BA and BC means significant differences between groups at $P<0.05$.

Table-2. pH value in four anesthetic protocols in dogs.

Time	Pre anesthesia 0 minute	Post anesthesia 10 minute	Post anesthesia 30 minute	Recovery
G1	7.38 ±0.033	7.33 ±0.004	7.31 ±0.018	7.33 ±0.006
G2	7.33 ±0.010	7.31 ±0.028	7.29 ±0.033	7.26 ±0.030
G3	7.25 ±0.068	7.30 ±0.042	7.39 ±0.037	7.42 ±0.052
G4	7.40 ±0.019	7.37 ±0.050	7.31 ±0.077	7.30 ±0.078

The different letters BA and BC means significant differences between groups at $P<0.05$.

systems of the patients. The anesthetics can cause hypoxia and acidosis, which influence recovery from anesthesia and can have fatal results in critically ill patients with diminished opportunities for compensation [13].

The present study was conducted to examine the effects of four different anesthetic protocols and the influence of pneumoperitoneum on the outcome of the anesthesia in twenty healthy dogs.

Materials and Methods

Both sexes of mixed breed of adult dog were used in the current study. The mean ±SE of their weight and age were 20± 1.3 kg and 1.8± 0.9 year, respectively.

Ethical approval:

All treated animals were received humane care according to the standard local guidelines. The study protocol was approved by the Animal House of the college of Veterinary Medicine, University of Mosul. The dogs were provided with free access to standard chow and tap water prior to the experiment.

Twenty dogs were divided into four group, five dog in each group. All animals were prepared aseptically for arterial blood sample collection from common carotid artery.

First group (G1):

Five animals were premedicated with xylazine at the dose 5 mg/kg intravenously, then 5 min later with Ketamine given intramuscularly at 15 mg/kg. Blood samples were collected into heparanized test tubes in secure aseptic condition at 10 and 30 min post injection and at recovery for blood gas analysis.

Second group (G2):

Five animals were subjected to the same treatment as the first group, peumoperitoneum with CO_2 done, blood gas sampling and parameters recorded in the same manners of the first group.

Third group (G3):

Anesthesia induced by propofol at 2 mg/kg intravenously. The trachea was intubated to maintain source of O_2 and inhalation with halothane 1-1.5% was used to maintain anesthesia. A Fluotec halothane vaporizer and closed rebreathing circuit were used. (Anesthetic machine/7400A). Unusual reactions linked with the administration of propofol were also observed.

Fourth group (G4):

Treatment was given same as the third group except the operative animals underwent pneumoperitoneuim with CO_2 at pressure 12 mmHg and flow rate 5 L/min [14,15].

In all groups the criteria recorded included: Onset of analgesia, disappearance of the pedal reflex, duration of anesthesia, duration of recumbency and recovery time. Two way analysis of variance (ANOVA) was used to determine the statistical significance. P value was considered significantly at $P<0.05$.

Results

All anesthetic protocols rapidly induced sedation –anesthesia and lateral recumbency within 1-3 min, but there are wide differences in the quality of anesthesia between the four groups as manifested by a significant differences in onset of action, induction, diminish of pedal reflexes duration of action and recovery time between first and second group (Table-1). There was adequate muscle relaxation, and analgesia for the surgical procedures to be performed. The time for intubation was 2.5-3.5 min fast, easy and convenient which was in the third and fourth groups. In spite of the rapid and smooth recovery after propofol anesthesia

Table-3. $paCO_2$ value in four anesthetic protocols in dogs.

Time	Pre anesthesia 0 minute	Post anesthesia 10 minute	Post anesthesia 30 minute	Recovery
G1	36.250±0.479	41.500±0.645	43.500±0.645	42.500±0.289
G2	33.000±0.408	45.750±0.479	44.000±0.408	46.000±0.408
G3	32.750±1.031	34.250±1.109	43.500±0.645	44.000±0.707
G4	35.500±0.957	44.750±0.213	53.750±1.031	56.250±0.750

Table-4. paO_2 value in four anesthetic protocols in dogs.

Time	Pre anesthesia 0 minute	Post anesthesia 10 minute	Post anesthesia 30 minute	Recovery
G1	72.000±0.913 Aa	88.500±0.645 Aa	97.000±0.913 Aa	115.000±1.080 Aa
G2	121.250±0.629 Aa	123.750±0.854 Aa	123.000±0.408 Aa	131.750±1.109 Aa
G3	113.000±1.08 Aa	376.750±0.56 Bb	405.75±0.32 Bb	335.75±0.5 Bb
G4	136.750±0.315 Aa	242.750±1.568 Bb	318.750±0.425 Bb	391.000±1.472 Bb

Different letters means significant differences between groups at $P<0.05$

bradycardia developed with transiting apnea during induction or anesthetic adjustment periods. This was most frequently observed in the third and fourth group which was alleviated with adequate ventilation by oxygen supply. The result of gas analysis showed no significant difference among the four treatment groups in pH (Table-2). There was no significant change in $paCO_2$ in second and fourth group once after anesthesia until recovery (Table-3). The paO_2 significantly increased 10 and 30 min after anesthesia in all the groups in comparison with respective pretreatment value (Table-4).

Discussion

General anesthesia was induced by using inhalational agent or the injectable propofol and ketamine. Ketamine and xylazine were selected because of the safe use for clinical anesthesia in several species of animals. The combinations induce rapid sedation with good analgesia and adequate muscular relaxation which are dose dependent [7]. Balanced anesthesia is characterized by muscle relaxation, unconsciousness and analgesia induced by combination of drugs each have different predominant mechanism action. It permits the decreases in the doses of drugs used and as well as their side effect [16]. Total intravenous anesthesia includes much more smooth recovery from anesthesia with minimal postoperative side effect as vomiting [17]. After the injection of xyalzine deep sedation occurs within 1-3 min in all operative groups. Bradycardia took place after being treated with xyalzine. This is due to the effect on vagal activity (decreased cardiac output) [18,19]. Bradycardia is a complication that frequently occurs in dogs during general anaesthesia [20]. After using ketamine, there are some complications including muscle rigidity. This occurs due to effect of ketamine on muscle tone and spontaneous muscle activity. For this reason, ketamine could not be used alone in dogs but can be used with alpha 2 -agonist as xylazine with minimum side effect [18].

Administration of propofol intravenously provided rapid anesthetic induction and recovery with very low frequency of occurrence of unusual reactions in local dogs premedicated with xylazine [21]. Propofol is highly lipid soluble, results in rapid blood brain equilibrium and hence rapid onset of action occurs. Rapid clearance makes it unsuitable as single intravenous but is used for maintenance [22]. We used it with halothane to obtain balanced anesthesia. In spite of these advantages, there are few signs after using propofol such as: pain on injection, apnea, cyanosis, excitement, retching and vomiting. Limb withdrawal during propofol injection was considered to be a sign of pain perception [23]. The signs of apnea in this study in third and fourth groups were alleviated by supplying of oxygen [24]. $PaCO_2$ increased immediately after 10 min post anesthesia until recovery especially in second and fourth group but not significantly. The hypercarpnia occurs due to the increase of CO_2 level in blood because of hypoxia due to insufflations with CO_2 gas [10, 25]. This suggests that bicarbonate level increased due to an increase of carbon dioxide level of blood during pneumoperitoneum in dogs. There were no significant changes especially in third and fourth group due to the use of endotracheal tube which provided continuous ventilation, so that respiratory acidosis did not occur [26].

100% O_2 inhalation throughout general anesthesia provided in endotracheal intubation cases. This provide compensation of the increase in blood CO_2 and prevent apnea [27]. Use of propofol alone [28] and with medetomidine increases the mean $PaCO_2$ in ponies which agrees with [29]. Increase in $paCO_2$ noticed during anesthetic period. It returns to normal at 15 minutes after termination of propofol infusion in buffalo calves [30].

The study revealed a significant increase in paO_2 10 and 30 min post anesthesia. This has not been consider before in other studies which found decreases the mean paO2 after propofol infusion in different species of animals including dogs [31,32]. It is suggested that the increase in paO_2 may be due to continuous supply with fresh oxygen.

Conclusion

It is concluded that laparoscopic interventions can safely be carried out without threatening the life of animals at high score of risk. Anesthesia with halothane and propofol was safe and suitable for laparoscopic interventions.

Authors' contribution

Both author contributed equally. Both author read and approved the final manuscript.

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Competing interests

Authors declare that they have no competing interest.

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