RESEARCH ARTICLE

Assessment of Anaesthetic Impact of Propofol Combined with Isoflurane Versus Sevoflurane for Thoracoscopy in Canines

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Abstract

The present study was undertaken to evaluate the anaesthetic effect of propofol isoflurane and propofol sevoflurane in twelve dogs with history of chronic cough, dyspnoea, laboured breathing, nasal discharge, exercise intolerance which were presented to the Department of Surgery and Radiology, Mumbai Veterinary College and Bai Sakarbai Dinshaw Petit Hospital for Animals, Parel, Mumbai. These dogs were randomly divided into two equal groups. In both the groups dogs were premedicated with acepromazine (0.04 mg/kg b.wt.) intravenously, and atropine sulphate (0.04 mg/kg b.wt.) and dexamethasone sodium (0.025 mg/kg b.wt.) SC 10 min before induction of anaesthesia. In both the groups, anaesthesia was induced with propofol (5 mg/kg b.wt.) intravenously. In group I anaesthesia was maintained using 2.5% isoflurane and in group II, 2.5% sevoflurane along with oxygen at a flow rate ranging from 500 to 1200 mL/min. History, physiological parameters, anaesthetic parameters were recorded at different time intervals during the study period. The present study findings suggest that induction with propofol and maintenance with isoflurane and sevoflurane proved best anaesthetic technique for thoracoscopy in dogs.

Key words: Anaesthesia, Dog, Isoflurane, Thoracoscopy, Sevoflurane.

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Introduction

Selection of appropriate anaesthetic protocol is very important factor for endoscopy and thoracoscopy in veterinary medicine. Evaluation of safe and adequate anaesthetic technique for thoracoscopy has high priority in veterinary minimal invasive thoracic surgeries. Minimum invasive surgeries like laparoscopy and thoracoscopy surgeries require specific anaesthesia. Without thorough knowledge of haemodynamic, physiological, and biochemical changes in relation to positioning of the animals during thoracoscopy procedures may cause potential complications (Richter, 2001). Hence, selection of safe anaesthetic protocol during thoracoscopic procedures is of utmost importance (Weil, 2009). Positive pressure ventilation during anaesthesia and thoracoscopy provides respiratory support to the patient by eliminating carbon dioxide and oxygenation of arterial blood after partial pneumothorax produced by thoracoscopy.

Unilateral hemithorax ventilation technique is a standard procedure in human thoracoscopy which includes bronchial blockade, endobronchial intubation, and use of double lumen endotracheal tubes (Walker and Bensky, 1995). However, both bilateral lung ventilation and unilateral lung ventilation techniques have potential risks during thoracoscopy, which need critical anaesthetic monitoring of the patient. But unilateral lung ventilation has greater risk of hypoxemia due to non-functioning and collapse of entire lung leading to atelectasis in non-ventilated lung (Karzai and Schwarzkopf, 2009). Even though bilateral ventilation is associated with lacunas like reduced field of view, difficulty while manipulation of intrathoracic organs and disturbance of vision due to spontaneous movements of lung, the technique has been used in veterinary as well human thoracoscopy successfully to avoid the effect of cardiopulmonary stress on the patient where unilateral lung ventilation was considered too dangerous (Hasnain and Krasna, 1994). This study was aimed to assess the anaesthetic impact of propofol combined with isoflurane versus sevoflurane for thoracoscopy in canines.

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Materials and Methods

The present study was undertaken on twelve clinical cases with history of chronic cough, dyspnoea, laboured breathing, nasal discharge, exercise intolerance, which were referred to the Department of Surgery and Radiology, Mumbai Veterinary

College and Bai Sakarbai Dinshaw Petit Hospital for Animals, Parel, Mumbai during 2018-2020. Initially, all the animals were subjected to thorough systemic investigation followed for recording of parameters, *viz.,* history (age, breed and body weight), physiological parameters, anaesthetic parameters and statistical analysis. All the dogs diagnosed with pleural effusions, pleuritis, pyothorax and lung parenchyma diseases were initially treated with standard medical protocol for two weeks, however, the cases which did not respond to the treatment were further randomly divided in two equal groups, *viz.,* Group I and Group II having six animals each for thoracoscopy.

In Group I, thoracoscopy was carried out for the examination of thoracic cavity and diagnosis of lung parenchyma diseases by lung biopsy under isoflurane anaesthesia, while in Group-II, thoracoscopy was carried out for the examination of thoracic cavity and diagnosis of pleural diseases with pleural fluid analysis and pleural biopsy under sevoflurane anaesthesia.

Preanaesthetics and Induction of Anaesthesia

In both the groups, dogs were premedicated with acepromazine (0.04 mg/kg b.wt.) intravenously, and administration of atropine sulphate (0.04 mg/kg b.wt.) and dexamethasone sodium (0.025 mg/kg b.wt.) SC 10 min before induction of anaesthesia. Induction of anaesthesia was carried out with propofol (5 mg/kg b.wt.) intravenously. After induction of anaesthesia each dog was intubated by endotracheal tube of appropriate size varying from 5.0-7.0 F according to the size of the dog. All the patients were positioned in dorsal recumbency and atracurium was administered (0.2 mg/kg b.wt.) intravenously as a bolus dose for respiratory muscle relaxation, thereafter the patients were shifted on volume controlled positive pressure ventilation and the dose of atracurium was repeated (0.1 mg/kg b.wt., IV, as per need.

Maintenance of Anaesthesia and Positive Pressure Ventilation

In group I, anaesthesia was maintained using 2.5% isoflurane and in group II, anaesthesia was maintained using 2.5 % sevoflurane along with oxygen at a flow rate ranging from 500 mL/min to 1200 mL/min. All the animals were maintained on volume controlled intermittent positive pressure ventilator, which was delivered with tidal volume of 7-8 mL/kg body weight by adjusting 15-16 breaths per minute and inspiratory: expiratory (I:E) ratio of 1:2. End tidal volume of CO_2 was monitored by multi paramonitor and $EtCO_2$was achieved in between 35 to 40 mm Hg. Following completion of the surgical procedure inhalation anaesthesia was stopped by switching off the dial setting of isoflurane vaporizer and intermittent positive pressure ventilation was maintained till the initiation of self-respiration and patient was weaned off the ventilator gradually to avoid mismatch of breathing. Further, oxygen was delivered to all the dogs, till the appearance of the swallowing reflex. The endotracheal tube was then removed after deflating the cuff of the tube once the gag reflex was noted in the dogs.

Physiological Parameters

A thorough physical examination was performed on all the animals before surgery, during surgery and after complete recovery from the anesthesia. Rectal temperature was measured with the help of a digital thermometer. Auscultation was carried out starting from the base of heart to the apex from left side to record heart rate. Heart rate was noted from the point of maximal intensity.

Anaesthetic Parameters

Quality of induction: The quality of induction of anaesthesia was judged by observing different characteristic signs like momentary apnoea, yawning reflex, loss of gag reflex, loss of palpebral reflex and pedal reflex. The quality of induction of anaesthesia was graded as excellent, good and poor according to Sano *et al.* (2003).

Quality of maintenance of anaesthesia: The quality of maintenance of anaesthesia was assessed on the vital visual signs shown by animals during surgical procedure. The time required from disappearance of pain reflexes after induction to the end of surgical procedure was considered as duration of maintenance of anaesthesia.

Quality of recovery of anesthesia post recovery: The dogs were observed for signs like retching, coughing, pawing of nose, hyperexcitablity, calmness or vomition during the recovery. On the basis of these signs the quality of recovery was graded as ++++ Smooth and fast, +++ Smooth and prolonged, ++ Struggling and fast and + Struggling and prolonged.

Results and Discussion

The effects on physiological parameters of propofol combined with isoflurane versus sevoflurane for thoracoscopy in canines are shown in Table 1. The mean rectal temperature was significantly decreased at 60 min during thoracoscopy in both the groups and returned to normal physiological values after 48 h. However up to first 30 min the decrease was non-significant in both the groups. Similar significant decrease in rectal temperatures was observed by Polis *et al.* (2002) in dogs with propofol and sevoflurane anaesthesia. Significant decrease in rectal temperatures was also observed by Bolaji-Alabi *et al.* (2018) with acepromazine-tramadol-propofol anaesthesia in dogs and Sobbeler *et al.* (2018) in dogs anaesthetized with isoflurane, sevoflurane, and propofol and alphaxalone anaesthesia. This decrease in rectal temperature could be due to peripheral vasodilatation due to muscle relaxation induced basal metabolic rate and effect of anaesthesia on hypothalamic thermoregulatory center (Sobbeler *et al.* (2018). However, Liu *et al.* (2013) recorded an elevation of rectal temperature on the first day after surgery in transoral endoscopic surgery and thoracoscopic surgery for lung biopsy and creation of pericardial window, whereas body temperature returned early to baseline values in thoracoscopic surgery. Bohaychuk-Preuss *et al.* (2017) observed non-significant reduction in body temperature in horses under ketamine-propofol and isoflurane anesthesia during thoracoscopy for lung biopsy.

The mean value of heart rate changed non-significantly within the group and between the groups. The heart rate increased non-significantly in group I and II during thoracoscopy up to 60 min and then returned to the baseline values by 48 h. Tachycardia could be due to the sympathetic stimulation induced by stress response related to the increase in $PaCO_2$ or due to the stimulation of baroreceptor reflex or due to cumulative effect of preanaesthetic medication or partial pneumothorax produced by room air during thoracoscopy as noted by Pigatto *et al.* (2008). Cantwell *et al.* (2000) noticed increase in the heart rate during thoracoscopy in dog with one lung ventilation. In contrast, Daly *et al.* (2002) and Wen *et al.* (2013) noticed significant decrease in heart rate during thoracoscopy in dog anaesthetized with acepromazine-thiopental-isoflurane combination and insufflated with carbon dioxide in pleural cavity and during subxiphoid thoracoscopic lung lobectomy in dog under isoflurane maintained anaesthesia. Pigatto *et al.* (2008) observed initial increased heart rate after production of pneumothorax with room air. Similarly, Bohaychuk-Preuss *et al.* (2017) recorded non-significant increase in heart rate along with increased intrapleural insufflation of carbon dioxide pressure during thoracoscopy in horses under general anaesthesia.

Quality of induction of anaesthesia in Groups I and II is shown in Table 2. It was overall excellent in both the groups. All the animals in both the groups showed smooth and rapid induction. In all animals profound jaw relaxation and suppression of pharyngeal reflex was observed after induction which allowed easy and smooth intubation of trachea for maintenance of anaesthesia. The preanaesthetic combination resulted no adverse drug or physiological effect. It was also observed that the excellent quality of induction of anaesthesia could be because of the preoperative care in diagnosis and thoracocentesis of cases essential, which reduced the pulmonary stress on the animals in this study. Doenicke *et al.* (1998) recommended propofol anaesthesia for induction in respiratory disease patients as it did not cause histamine release in human patients, Kulkarni (2012) also mentioned similar findings in dogs. Cattai *et al.* (2018) observed smooth and rapid induction, short duration, lack of accumulation on repeated administration and no excitatory effects on induction, during maintenance and recovery in dogs premedicated with acepromazine and induced with propofol. In this study it was observed that acepromazine-propofol anaesthesia was suitable for induction of anaesthesia for thoracoscopic procedures like lung biopsy and pleural biopsy and thoracoscopic examination in dogs.

The quality of maintenance of anaesthesia in terms of degree of muscle relaxation (Table 2) was found to be excellent to good in both the groups. There were no signs of pain or discomfort observed during surgery. All the dogs showed optimum muscle relaxation required for performing the thoracoscopy. This could be achieved because of combination effect of atracurium and acepromazine in this study. In group I, two cases resulted in to mismatch of respiration after shifting on the ventilator, animal showed discomfort for respiration and cyanosis. Immediately the ventilator was shifted on standby mode and cases were stabilized by supplying fresh oxygen through endotracheal tube. Mismatch of respiratory pattern showed may be due to inadequate muscle paralysis and presence of spontaneous respiration of the patient. However, it was noted that animal should be shifted on the ventilator after observing complete apnea. Separate anaesthetist should be present for monitoring long term anaesthesia and ventilation during thoracoscopy. Vesal and Parazi (2012) performed repair of diaphragmatic hernia under volume controlled positive pressure ventilation in dog and suggested ventilatory settings of tidal volume 10-15 mL/kg, peak inspiratory pressure of 15-20 cm H_2O, I:E ratio of 1:2 safe during surgery which maintained end tidal volume CO_2 within normal range. They suggested starting the ventilation soon after induction of anaesthesia and tracheal intubation. Atencia *et al.* (2013) performed pericardial window creation for management of pericarditis in dog under propofol and isoflurane anaesthesia with one lung ventilation and observed that anesthesia provided adequate haemodynamic stability and rapid uncomplicated recovery from anaesthesia. However, in present study the animals were shifted on the ventilation

Table: 1: The effects of propofol combined with isoflurane versus sevoflurane for thoracoscopy in canines on physiological parameters

Parameters	Groups	Before anaesthesia	Period after anaesthesia			
			15 min	30 min	60 min	48 h
Mean rectal temperature (°F)	I	101.10±0.38	100.58±0.26	100.18±0.17	99.97±0.13	101.40±0.31
	II	101.58±0.16	101.20±0.24	100.95±0.29	100.62±0.21	101.68±0.14
Mean heart rate (bpm)	I	103.33±4.93	105.00±4.46	107.33±4.69	110.0±4.72	105.3±1.45
	II	107.33±4.10	113.0±1.37	113.5±3.55	115.5±3.13	106.3±2.08

Table 2: Quality of induction of anaesthesia, degree of muscle relaxation, quality of recovery and Total time of recovery from anaesthesia in dogs of Groups I and II

Dog No.	Quality of induction		Degree of muscle relaxation		Quality of recovery		Total time of recovery from anaesthesia	
	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II
1	A	A	Excellent	Excellent	++++	++++	27	25
2	A	B	Excellent	Good	++++	++++	30	28
3	B	A	Excellent	Excellent	++++	++++	29	27
4	A	A	Excellent	Excellent	+++	++++	32	26
5	A	A	Good	Good	++++	++++	25	24
6	A	A	Good	Excellent	+++	+++	28	26
			Mean ± SE				**28.5±0.99**	**26.0±0.58**

after complete cessation of respiration by neuromuscular blockade, as there was no pneumothorax created. The balanced anaesthetic techniques used in this study were found adequate, allowing the patients to early recovery breathe adequately resulting in minimal intraoperative and postoperative complications. Lansdowne *et al.* (2005) and Kulkarni (2012) performed successful thoracoscopic lung lobectomy and laparoscopic ovariectomy, respectively, in dogs under acepromazine-propofol-isoflurane and morphine-propofol-sevoflurane anaesthesia and observed excellent quality of maintenance of anaesthesia and short-term recovery without complication. Lee *et al.* (2014) and Datir (2018) also performed thoracoscopic assisted lung lobectomy under acepromazine-propofol-isoflurane anaesthesia in dog and stated that this anaesthesia combination allowed the performance of the procedure without morbidity.

The quality of recovery and total time required (min) for recovery from anaesthesia in group I and II are shown in Table 2. Time required for complete recovery in group I was non-significantly longer than the group II (28.5± 0.99 vs. 26.0 ± 0.58 min). The time required for lifting of head, for sternal recumbency and standing in group II was shorter than group I, but it was not significant. The three dogs in group I showed signs of mild ataxia during recovery which was not observed in group II. Dogs in group II showed early signs of attempt to stand than group I, one dog required assistance for standing in group I. Administration of equal dose of acepromazine and propofol could be attributed to the non-significant difference of recovery time in both the groups. Love *et al.* (2007) reported that there was no difference in recovery time for isoflurane and sevoflurane anaesthesia in dogs, however, sevoflurane showed smother recovery than isoflurane. Bennett *et al.* (2008) stated that the characteristic of sevoflurane anaesthesia was similar to isoflurane anaesthesia in clinical conditions. Faster and smoother recovery with sevoflurane was advantageous. Dhumeaux and Haudiquet (2009) and Laksito *et al.* (2010) performed thoracoscopic lung resection to treat lung tumor in dog under isoflurane anaesthesia and reported that anesthesia was safe for maintenance and recovery was fast with no adverse effect. In the present study, it was noted that there was no significant difference between isoflurane and sevoflurane anaesthesia for time of recovery, however quality of recovery was fast and smooth in sevoflurane group, further both the anaesthetic protocol were found suitable for thoracoscopy in dogs. Kulkarni (2012) also witnessed smooth recovery when isoflurane was used for laparoscopic procedures in dogs.

Conclusion

On the basis of the detailed study of the various anaesthetic parameters it was concluded that induction with propofol and maintenance with isoflurane and sevoflurane proved best anaesthetic technique for thoracoscopy in dogs. Thoracoscopy without insufflation of CO_2 with bilateral positive pressure ventilation does not cause any adverse cardiopulmonary effects on the patients.

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