ARAŞTIRMA MAKALESİ

RESEARCH ARTICLE

Comparison of the effects of isoflurane and halothane anaesthesia on haemodynamic balance in canine thoracic surgery

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S U M M A R Y

This study was performed to investigate the effects of isoflurane and halothane anaesthesia on haemodynamic parameters and blood gases in thorax surgery of dogs. Twenty, free-living, cross-breed dogs weighing 24.2 ± 4 kg, were equally divided into two groups as isoflurane and halothane. Atropine sulphate (0.04 mg/kg), xylazine hydrochloride (2 mg/kg) were injected for sedation. Thiopental sodium (15 mg/kg) and fentanyl citrate (5µg/kg) were injected intravenously for induction. Dogs were ventilated for 16 times/min to maintain the 15 ml/kg of tidal volume. A right side thoractomy was performed. Anaesthesia was maintained by either 1.5 % of isoflurane or halothane. Hearth rate (HR), minimal arterial pressure (MAP), cardiac output (CO), central venous pressure (CVP), right ventricular pressure (RVP) pulmonary arterial pressure (PAP), pulmonary capillary wedge pressure (PCWP) as well as blood gases were recorded at 0, 15, 30, 60 and 120 min. of the anaesthesia. Significant differences were determined between two groups at 0, 15, 30 and 60 min. in HR and at 0 and 15 min. in PCWP. Hearth rate was increased at 15 min. in halothane group, and at 30 min in isoflurane group, and thereafter it returned to the initial levels in both groups. Decreases were determined in MAP and CO levels in halothane group while MAP levels were stable in isoflurane group. In conclusion, anaesthesia with isoflurane was safer than the anaesthesia with halothane in the thoracic surgery of dogs.

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Izofloran ve halotan anestezisinin kanin toraks cerrahisinde hemodinamik dengeye olan etkisinin karşılaştırılması

Ö Z E T

Bu çalışma köpeklerde toraks cerrahisinde izofloran ve halotan anestezisinin hemodinamik parametrelere ve kan gazlarına etkisini araştırmak için gerçekleştirilmiştir.Ağırlıkları 24,2 ± 4 kg olan 20 karışık ırk köpek eşit olarak izofloran ve halotan grubu olmak üzere 2 'ye ayrıldı. Atropin sülfat (0,04 mg/kg, subkutan) enjeksiyonunu izleyerek ksilazin hidroklorid (2 mg/kg, intramuskuler) verilmesiyle sedasyon sağlandı. İndüksiyon pentotal sodyum (15 mg/kg) ve fentanil sitrat'ın (5 mcg/kg) intravenöz enjeksiyonuyla sağlandı. Köpekler tidal volüm 15 ml/kg olacak şekilde dakikada 16 kez ventile edildi. Sağ torakotomi her iki grupta gerçekleştirildi. Anestezi idamesi % 1,5 izofloran ve halotan ile sürdürüldü. Kalp atım sayısı (HR), ortalama arteriyel kan basıncı (MAP), kardiak debi (CO), santral venöz basınç (CVP), sağ ventrikül basıncı (RVP), pulmoner arter basıncı (PAP), pulmoner kapillar veç basıncı (PCWP) ve kan gazları, anestezinin 0, 15, 30, 60 ve 120. dakikalarında kaydedildi. HR'de iki grup arasında 0, 15, 30 ve 60. dakikalarda, PCWP ise 0 ve 15. dakikalarda fark gözlendi. HR, halotan grubunda 15. dakikada, izofloran grubunda ise 30. dakikada arttı. Sonraki zamanlarda başlangıç seviyesine indi. MAP ve CO'da Halotan grubunda düşüş gözlenirken, İzofloran grubunda stabil kaldı. Sonuç olarak, köpeklerde toraks cerrahisinde izofloran anestezisi halotan anestezisine göre daha güvenli bulunmuştur.

INTRODUCTION

Inhalation anaesthetics such as isoflurane and halothane are widely used in veterinary medicine. Isoflurane causes less cardiac depression than halothane. Isoflurane depresses cardiac contractility while has no effect on cardiac output (CO) and it causes a dose-dependent decrease in mean arterial pressure (MAP). Heart rate (HR) is generally stable during the isoflurane anaesthesia.[1-4] An isoflurane concentration of 1.25 % does not cause disorders in myocardial contraction. However, 2 % of isoflurane concentration results in negative inotrophic effect[5]. Minimal alveolar concentration (MAC) of isoflurane slightly changes the cardiac index and increases microcirculation by increasing coroner blood flow. Fentanyl and isoflurane can be used in myocardial ischemia[6]. Hypotension can be occurred due to the deepness of the anaesthesia with halothane. Halothane causes vasodilatation, and it decreases total peripheral resistance by depressing the vein smooth muscle. In previous studies,[7,8] it was reported that halothane anaesthesia reduced the progressive systemic vascular resistance depending on the doses in dogs.

Isoflurane and halothane are anaesthetic agents that depress the respiratory system in a dose dependent manner. The tidal volume is decreased in the anaesthesia with halothane. However, increase in tidal volume and decrease in the respiratory rate are observed at the beginning of deep anaesthesia with isoflurane. Isoflurane has minimal effects on bronchial smooth muscle and secretion.[8-11]

Drugs for premedication are recommended to avoid the respiratory depression and irritation in the anaesthesia with isoflurane. Isoflurane is preferred in the anaesthesia for the patient with bronchospasm because of its preventive effects on pulmonary and bronchial vasoconstriction.[11]

Monitoring of HR, MAP, CO, central venous pressure (CVP), right ventricular pressure (RVP) pulmonary arterial pressure (PAP), pulmonary capillary wedge pressure (PCWP) during operation is of importance for predicting the prognosis and furhter to avoid the death of the animal due to cardiac arrest.[11-14]

Therefore, this study was performed to compare the effects of isoflurane and halothane anaesthesia on haemodynamic parameters and to determine a safer anaesthetic agent that can be used in thoracic surgery in dogs.

MATERIALS AND METHODS

Animals

Twenty, free-living, cross-bred dogs, weighing 24.2 ±4 kg were the materials of the study. Isoflurane was administered to 10 dogs and halothane was administered to the remaining 10 dogs.

The ethical committee approval was obtained from the Faculty of Veterinary Medicine, University of Ankara (approval number: 18).

Anaesthesia

Premedication: Premedication was achieved by subcutan injection of 0.04 mg/kg of atropine sulphate (Vetaş, Turkey) and by intramuscular injection of 2 mg/kg of xylazine hydrochloride (Rompun, Bayer, Germany) following 24-hour fasting.

Induction: Induction in both groups were performed by intravenous injection of 15 mg/kg of thiopental sodium (Pental sodium, İ.E. Ulugay, Turkey) and 5 μg/kg of fentanyl citrate (Abbott, USA). Dogs in both groups were ventilated for 16 times/min. to maintain the 15 ml/kg of tidal volume.

Surgery

A right side thoracotomy was performed between the 4th and 5th ribs under the general anaesthesia. Pericardium was dissected and fixed with suture. Thorax was kept open during the measurements and closed at the end of the measurements and postoperative nursing was carried out until the complete clinical healing.

Anaesthetic agents were administered by a close anaesthesia system with automated ventilator and double vaporizer (Junior 620, AMS, Turkey). Intubations were performed by 7-8 F disposable intubations tubes. Isoflurane (Forane liquid, Abbott, England) and halothane (Fluothane, Zeneca Abdi İbrahim İlaç, Turkey) were used in isoflurane and halothane groups, respectively. Anaesthesia was maintained either with 1.5 % isoflurane or 1.5 % halothane.

An 18 G catheter was introduced to *vena cephalica antebrachia* for the application of anaesthetic agents and serum. Swan-Ganz thermodilution catheter that was balloon type with three lumens (7F, 115 cm, ABBOTT Critical Care System, IL) was introduced to *v. femoralis* for the measurements of CVP, RVP, PAP, and PCWP. Arterial catheter (20 cm, Deltacath, Becton Dcinson, USA) was introduced to *a. femoralis* for the measurements of the arterial pressure and blood sample collection. Transducer (Cobe Laboratories Inc., USA) was used to monitor blood pressure on a multichannel monitor (PETAŞ Ltd., Turkey) for continuous observation of haemodynamic parameters. An automatic cardiac output computer (Deseeret 1000, Deseeret Med Inc., USA) was used for the cardiac output measurements (pCO_2, pO_2, HCO_3 and base excess). Blood gases were measured with a blood gas analyser (AVL Compact I, Turkey).

All of the monitorization values and blood samples for blood gas analysis were collected at 0, 15, 30, 60, 90 and 120 mins. during the anaesthesia.

Statistical Analysis

Data were analysed by SPSS 9.0 version for Windows. Differences between two groups were determined by independent *t*-test and differences between the sampling times within the group were determined by paired sample t test. Data were expressed as means ± standard error of means (SEM).

RESULTS

Statistically significant differences were determined between two groups at the beginning (at 0 min) ($p<0.05$) and at 15th min ($p<0.001$), 30th min ($p<0.05$) and 60th min ($P < 0.01$) in HR values and at 0 min ($p<0.001$) and 15th min ($p<0.05$) in PCWP values. No statistically significant differences were seen between two groups in the other parameters.

In the halothane group, HR values were changed between 0 and 15 min, and 15 and 60 min ($p<0.05$); 15 and 120 min ($p<0.001$); 30 and 60 min ($p<0.05$); 30 and 120 min ($p<0.001$) and 60 and 120 min ($p<0.01$). MAP values were changed between 0 and 120 min ($p<0.05$) and CO values were changed between 60 and 120 min ($p<0.05$).

In isoflurane group, differences in HR were significant between 0 and 30 min, 30 and 60 min, and 30 and 120 min ($p<0.05$). No statistically significant differences were observed in the other parameters with regard to sampling time in both groups (Tables 1 and 2).

Table 1. Haemodynamic parameters in halothane and isofluorane anaesthesia in dogs

Çizelge 1. Köpeklerde halotan ve izofloran anestezisinde hemodinamik parametreler.

Parameters and sampling time (min.)	Halothane group	Isofluorane group
HR		
0	114±7	92±4
15	130±4	89±4
30	126±4	109±5
60	115±6	89±3
120	105±5	94±2
MAP (mmHg)		
0	101±12	91±10
15	82±8	69±8
30	78±7	71±12
60	74±3	72±8
120	69±5	68±5
CO (L/min.)		
0	1.48±0.39	0.69±0.04
15	1.72±0.58	0.69±0.07
30	1.82±0.57	0.70±0.05
60	1.75±0.59	0.80±0.12
120	1.50±0.53	0.68±0.07
CVP (mmHg)		
0	6±1	8±1
15	6±1	8±1
30	7±1	8±1
60	7±1	8±1
120	7±1	8±1
RVP (mmHg)		
0	24±2	23±1
15	23±4	22±3
30	26±2	26±2
60	23±1	24±1
120	22±1	23±1
PAP (mmHg)		
0	21±1	24±2
15	19±1	21±2
30	20±1	21±2
60	20±1	21±1
120	19±1	21±1
PCWP (mmHg)		
0	6.4±1.4	11.2±2.7
15	5.9±0.5	9.6±1.3
30	6.0±0.5	8.3±1.3
60	8.3±1.0	10.1±1.4
120	7.0±2.3	10.0±3.8

DISCUSSION

In the present study, statistically significant differences were seen between halothane and isoflurane anaesthesia at the beginning (at 0 min) of the study in HR and PCWP values. These differences between two groups may result from the dose of the drug used for the induction of the anaesthesia rather than the halothane or isoflurane itself. Although, differences between two groups in HR and PCWP at the 15th min and in HR at the 30th and 60th min were significant, the other values remained within physiological levels.

Increased HR at the 15th and 30th min returned to the initial levels at the 60th min and even lower levels at the 120th min in halothane group. This decrease may be due to the decreased cardiac output, stroke volume and cardiac contractility depending on direct depression of myocardium by halothane[7,8].

In isoflurane anaesthesia, stability in HR confirmed the findings of Seagard et al[1] who reported that stability in HR depending on the stability in CO. In the present study, CO was changed in the halothane group while no effect of isoflurane was observed on CO as indicated previously[4]. Changes in CO in the halothane group may result from the depressive effect of halothane on cardiac contractility[4,7,8].

In this study, isoflurane did not affect MAP while halothane did. In the halothane group, although a continuous decrease was observed in MAP with the time, it remained within the physiological range. Therefore no medical treatment was performed. The decreased MAP confirmed halothane dependent hypotension due to vasodilatation[7,8]. Fagraeus et al[5] reported that administration of isoflurane at a concentration of 2% caused a negative inotropic effect. In contrast, in the present study, 1.5% of isoflurane had no negative inotropic effect. In the present study, lack of the effects of both anaesthetic agents on some haemodynamic parameters and on

blood gases may be associated with the liquid replacement and oxygen supply during the anaesthesia.

The results of this study suggest that isoflurane provides a more stable and safer anaesthesia than halothane in dogs ■

Table 2. Blood gase parameters in halothane and isofluorane anaesthesia in dogs
Çizelge 2. Köpeklerde halotan ve izolfloran anestezisinde kan gazları.

Parameters and sampling time (min.)	Halothane group	Isofluorane group
pH (-log [H+])		
0	7,47±0,03	7,43±0,03
15	7,46±0,03	7,40±0,02
30	7,42±0,04	7,39±0,03
60	7,40±0,02	7,40±0,05
120	7,40±0,05	7,38±0,02
PCO_2 (mmHg)		
0	33±2	27±5
15	30±3	31±2
30	35±2	32±2
60	37±2	32±2
120	35±4	30±2
PO_2 (mmHg)		
0	405±43	350±45
15	372±46	300±60
30	364±43	273±40
60	358±38	290±46
120	349±42	277±43
BE (mmol/L)		
0	0,01±6,5	-6,35±6,07
15	-0,59±6,67	-1,6±2,95
30	-0,95±5,57	-2,63±3,97
60	-0,83±6,47	-2,67±4,27
120	-1,12±5,97	-4,17±3,34
HCO_3 (mmol/L)		
0	21,5±7,34	17,85±5,51
15	21,06±7,08	18,86±4,42
30	21,43±4,09	17,41±2,91
60	21,23±5,56	16,61±2,30
120	21,62±7,44	17,76±2,78
O_2 SAT (%)		
0	99,8±0,16	99,8±0,12
15	99,8±0,13	97,6±1,54
30	99,8±0,1	97,9±1,2
60	99,6±0,2	99,4±0,4
120	99,7±0,2	99,6±0,2

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