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Original Article

Cardiovascular effects of thiopental-sevoflurane compared with thiopental-isoflurane in angora goats undergoing ovariectomy

Ankara keçilerinde ovariektomi operasyonlarında tiopental-sevofluran ile tiopental-isofluran'ın kardiyovasküler sistem üzerine etkilerinin karşılaştırılması

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ABSTRACT

Aim: The purpose of this study was to evaluate the effects of inhalation anaesthetics on cardiovascular functions in 16 healthy female Angora goats undergoing ovariectomy.

Material and Methods: Anaesthesia was induced with thiopental sodium then maintained with isoflurane or sevoflurane in oxygen. Cardiovascular parameters were measured before and at 0, 15th, 30th, 60th and 90th minutes after induction of anaesthesia. Recovery variables including time to extubation, first lift of the head, thoracic recumbency and standing up were also recorded.

Results: The mean induction dose of thiopental was 18.23 ± 3.87 mg / kg. There were no significant differences between groups for heart rate (HR), respiration rate (RR), noninvasive blood pressure and body temperature measured prior to and under anaesthesia. All animals recovered uneventfully in both groups.

Conclusion: There were no statistical differences between groups for their cardiovascular parameters and recovery times although the results of this study showed a rapid recovery time in each parameter for sevoflurane anaesthesia. On the basis of the results, sevoflurane and isoflurane are suitable inhalation anaesthetics in goats.

Keywords: anaesthesia; sevoflurane, isoflurane; angora goat; cardiovascular

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ÖZ

Amaç: Bu çalışmada 16 adet sağlıklı Ankara keçisinin ovarektomi operasyonlarında kullanılan inhalasyon anesteziklerinin kardiyovasküler sistem üzerine etkilerinin değerlendirilmesi amaçlanmıştır.

Gereç ve Yöntemler: Anestezinin indüksiyonu tiopental sodyum ile yapılmış ve devamında izofluran ve sevofluran inhalasyon anestezikleri kullanılmıştır. Kardiyovasküler değerler indüksiyondan önce ve indüksiyon sonrası 0. 15. 30. 60 ve 90. dakikalarda kayıt edilmiştir. Ekstubasyon ve kafayı ilk kaldırma zamanı, sternal pozisyona gelme ve ayağa kalkma zamanları uyanma kriterlerini oluşturmuştur.

Bulgular: Tiopental sodyumun ortalama indüksiyon dozu 18.23±3.87 mg/kg olarak belirlenmiştir. Gruplar arasında, anestezi sırasında ve anesteziden önce nabız sayısı, solunum sayısı, noninvaziv tansiyon değerleri ve vücut ısısında farklılık gözlenmemiştir. Tüm hayvanların anesteziden uyanmaları sorunsuz bir şekilde gerçekleşmiştir.

Sonuç: Çalışmanın sonucunda kullanılan anesteziklerin uyanma zamanları ve kardiyovasküler değerler üzerine etkileri arasında istatistiksel olarak farklılık olmadığı tespit edilmiştir. Sevofluran anestezisinde tüm uyanma kriterlerinin daha hızlı şekillendiği görülmüştür. Sonuç olarak her iki anestezik maddeninde keçilerin inhalasyon anestezisinde kullanımının uygun olduğu kanısına varılmıştır.

Anahtar kelimeler: anestezi; sevofluran; isofluran; ankara keçisi kardiyovasküler,

Introduction

Ovariectomy provides many advantages for livestock animals, such as easier handling, prevents pregnancy and also reduce problems related to the estrous cycle. Another purpose of ovariectomy in livestock animals include enhancement of weight gain performance (faster weight gain) and improvement of the carcass quality [1-2]. Sevoflurane and isoflurane are most commonly used inhalant agents for anaesthesia in small ruminants. Sevoflorane is a non-flammable agent that provides rapid induction and recovery from anaesthesia and easy control of the depth of anaesthesia. It has a lower blood/gas partition coefficient and rapid recovery time compared to isoflurane. The cardiovascular effects of these agents are similar. Both agents cause a dose dependent myocardial depression and decrease in arterial blood pressure. At higher doses they affect cardiac output [3-6]. In spontaneously ventilating goats, the heart rate was measured higher during anaesthesia than preanaesthesia [4].

The aim of this study was to determine the effects of thiopental-sevoflurane and thiopental-isoflurane anaesthesia on the cardiovascular system and recovery time in spontaneously ventilating Angora goats undergoing ovariectomy.

Material and Methods

Animals

This research was approved by the Animal Research Local Ethics Committee of Kirikkale University. Sixteen healthy female Angora goats were used in the study. The age of the goats varied between 3 - 6 years and the weight between 39.4 - 49 kg. The goats were randomly allocated into two groups; sevoflurane (n=8) and isoflurane group (n = 8). The animals were considered healthy on the basis of physical examination, complete blood count and serum biochemical analyses. All goats were fed ad libitum with ruminant concentrate and hay. Food was withheld for 18 hours prior to anaesthesia, but water was unrestricted until the time of operation.

Anaesthesia

An intravenous catheter was placed in the auricular vein for induction of anaesthesia and fluid administration. Another catheter was inserted in the auricular artery for measurement of blood pressure (Petaş, KMA 800, Turkey). Anaesthesia was induced with 10 mg/kg initial dose of thiopental sodium (Pental®Sodyum 1g, I.E. Ulagay, Turkey). Additional doses were required to provide adequate depth of anaesthesia. Tracheal intubation was performed after the jaw tone was reduced and there was no lingual response to traction. Anaesthesia was maintained with either isoflurane (Isoflurane-usp®, Adeka, Turkey) (1.5 - 3%) or sevoflurane (Sevorane®, Abbott, UK) (2.5 - 4%) concentration as 100% oxygen at 3 L/min in spontaneously ventilating goats. An orogastric tube was introduced for prevention of tympany. Meloxicam (0.5 mg/kg) (Maxicam, Sanovel, Turkey) was administered intravenously to provide perioperative analgesia. The heart rate (HR), respiratory rate (RR), end-tidal CO2 (EtCO2), and oesophageal temperature were recorded (Petaş, KMA 800, Turkey). All of these parameters

were measured prior to anaesthesia, at induction and 15, 30, 60 and 90 minutes thereafter. All goats kept in dorsal recumbency for the duration of operation and connected to a semi-closed circle rebreathing system (TMS Maxi 2000, Turkey). The fresh gas flow was 3 l/min. Lactated ringer solution (Ringesol, Vilsan, Turkey) was administered at a dose of 10 ml/kg/hr intravenously throughout the anaesthesia. Ovariectomy was performed following a median laparotomy. Recovery times were recorded after surgery. Local ethics committee approved the study and informed consent was obtained from participant(s)

Statistical Analysis

Statistical analyses were performed with commercial software (SPSS Inc., Chicago, IL,USA). Data were reported as median±IQR. Changes in HR, RR, mean arterial blood pressure (MABP), systolic arterial blood pressure (SABP), diastolic arterial blood pressure (DABP) and body temperature and the difference in recovery times between groups were evaluated with analyses of variance (ANOVA). Friedman test was used to compare values within each groups and differences between groups was determined by the Mann-Whitney U test after the test of normality. P value < 0.01 was considered as significant.

Results

The mean dose of thiopental sodium, which was required for intubation, was 18.23 ± 3.87 mg/kg (mean ± SD) in all groups. After administration of thiopental sodium, intubation was performed easily. In one case of the sevoflurane group apnoea occurred after induction that lasted more than 30 seconds. In this case, the intermittent positive pressure ventilation initiated manually and the spontaneous breathing restarted within two minutes. There were no other complications.

There were no significant differences between groups for HR, RR, MABP, SABP, DABP and body temperature measured prior to and under anaesthesia (Table 1).

Table 1. Maintenance data comparing isoflurane and sevoflurane in Angora goats (minutes).

Anaestheticagent	Parameter	Baseline	After Thiopental	5 min	15 min	30 min	60 min	90 min
	HR*	74.00±10	97.50±9	96.00±20	87.50±25	87.50±19	94.00±14	93.00±12
	MABP*	99.00±18	105.00±25	77.00±42	69.00±32	71.50±38	75.00±36	76.50±37
Isoflurane	DABP*	79.00±13	86.00±15	63.50±30	57.00±32	60.50±28	66.50±29	67.00±25
	SABP*	124.00±17	116.00±17	93.50±36	84.00±39	86.00±37	88.50±33	91.00±26
	RR	24.00±3	18.00±4	21.00±7	24.50±15	27.00±17	32.00±16	27.50±15
	Temp*	39.30±0.7	39.20±0.7	39.00±1.0	38.95±0.5	38.70±0.3	38.35±0.4	38.10±0.0
	HR*	75.50±18	97.50±36	95.50±30	88.00±17	85.50±9	91.50±26	89.50±31
	MABP*	100.00±31	81.50±27	63.50±20	76.00±13	71.00±11	72.00±18	69.50±16
Sevoflurane	DABP	75.00±26	69.50±24	50.00±24	64.50±20	63.00±9	59.00±25	62.00±20
	SABP	120.00±38	96.50±33	81.00±17	94.00±19	85.00±26	89.00±25	88.50±15
	RR	24.50±3	16.50±9	18.50±10	29.00±9	30.00±14	29.00±14	26.00±28
	Temp*	39.05±1.3	38.90±1.4	38.50±1.0	38.65±1.3	38.65±1.0	38.45±1.0	39.00±1.0

*Significant change with time within the same group (p<0.01).

All animals recovered uneventfully in both groups. Three goats regurgitated a small amount of gastric content in the isoflurane group during the postoperative period. The recovery time was shorter in sevoflurane than isoflurane group, but these differences were not statistically significant (Table 2).

Table 2. Event variables for goats recovering from isoflurane and sevoflurane anaesthesia (minutes).

Parameter (min.)	Isoflurane	Sevoflurane
Extubation	17.50±9	14.50±4
First lift of the head	25.00±32	22.00±8
Thoracic recumbency	44.00±31	39.50±42
Standing up	60.00±20	54.50±43

Discussion

Administration of any sedative agent is not recommended before induction of anaesthesia in sheep and goats because of regurgitation risks and late recovery time. An anaesthetic agent with short duration of action is recommended to provide calm and rapid induction instead of a sedative drug [7,8]. It was reported that thiopental provides short duration of action time (10 - 20 min.) in goats [9]. In this study, thiopental provides an adequate depth of anaesthesia for intubation, and there were no negative effect during the post-operative recovery.

Prassinos et al. (2005) reported that intubation was accomplished easily 1 minute after thiopental injection. In the present study, thiopental provided a rapid induction and easy intubation.

Thiopental has a wide range of administration dose (7 - 20 mg/kg) without premedication in goats. The initial dose of thiopental was 5 - 7 mg/kg to avoid the side effects. The initial dose applied during 30 seconds to evaluate the effects of the administered dose on the central nervous system [8]. Hikasa et al. (2002) recommended that 14.3 mg/kg thiopental is safe for goats. In a similar study, 8 mg/kg dose of thiopental was caused apnea in two of seven goats [7]. Branson (2007) reported that 8 - 15 mg/kg dose of thiopental sodium provided a sufficient depth of anesthesia for induction in small ruminants. In the present study, we recorded that less than 10 mg/kg of thiopental was not enough for intubation in Angora goats. We found that 18.23 ± 3.27 mg/kg mean dose of thiopental provided sufficient depth of anesthesia to achieve intubation in Angora goats.

Arterial hypoxia was reported after administration of thiopental in small ruminants, and its intensity varies depending on the individual characteristics [7]. In the study reported here, a hundred percent oxygen was given through the endotracheal tube during the study period. Capnography values were in reference limits (≤ 35 mmHg) throughout anaesthesia period except in a goat (≥ 55 mmHg) in which occurred apnea after thiopental injection and resolved within 3 minutes following mechanical ventilation.

Regurgitation is an important complication before tracheal intubation in small ruminants [6,10]. In a study, four of seven goats regurgitated after thiopental anaesthesia [7]. Basis on the result of our study, we suggest that 18.23 mg/kg mean dose of intravenous thiopental administration depresses both swallowing and laryngeal reflex and provides sufficient depth of anaesthesia for tracheal intubation. After administration of thiopental, the incidence of regurgitation in this study was lower compared to a previous study by Prassinos et al. (2005). The low regurgitation rate might have occurred due to the fact that the dose thiopental administered in this study was 2 – 3 times higher compared to that study by Prassinos et al. (2005). The high dose of thiopental administration depressed both laryngeal and swallowing reflex and intubation was easy without any complication and delaying. In our study, regurgitation occurred in three goats during the postoperative period. Active regurgitation in the postoperative period could have been related to surgery or postoperative pain.

It has been reported that thiopental increases the heart rate in goats and dogs [7,11]. In the present study, the heart rate increased after administration of thiopental and remained high throughout anaesthesia.

Isoflurane and sevoflurane increase the heart rate in dogs, goats [3,4,12,13], whereas the heart rate remains unchanged in horses and calves [14,15]. Contrary to dog and goat, the rate generally decreases in cat, sheep and lambs [6,16,18]. In the present study, the heart rate increased after both administration of thiopental and inhalation anesthesia. This condition related with baroreceptor reflex.

MABP, SABP and DABP are increased in dogs and decreased in goats [5,11]. In the present study, it was found that DABP increased slightly while SABP and MABP values were decreased. It could be suggested that SABP and MABP decreased because of the high dosage of thiopental.

Isoflurane and sevoflurane cause a dose dependent decrease in blood pressure, cardiac output and systemic vascular resistance in goats, dog, horse and sheep [3-5,19]. SABP, DABP and MABP values are decreased in dog, horse, goat [12-14]. SABP and DABP values increased under isoflurane and sevoflurane anaesthesia in sheep, but these changes were insignificant between isoflurane and sevoflurane groups [6]. As suggested by Mohamadnia et al. (2008), the reason of this rise in values was associated with painful orthopaedic surgery. In the present study, after the administration of inhalation agents, SABP, DABP and MABP values decreased as early as beginning of the anaesthesia and these values increased within 15 minutes and began to decrease toward to the end of the study. Such a change could be related to the type and severity of surgical manipulations in the ovaries. The DABP values were found nearly to levels of preoperative anaesthetic until end of the operation.

Sevoflurane and isoflurane can cause a dose dependent decrease in RR in dogs, horses, sheep and goats [12-14,19]. In the present study, RR decreased after induction with thiopental but neither isoflurane nor sevoflurane caused significant effects in RR.

In previous studies, the time to standing was shorter for sevoflurane than isoflurane anaesthesia in horse, sheep, calf, lamb, goat and dog [3,4,13,20-22]. It was reported that sheep were extubated in 6.37 and 7.66 minutes when anaesthetized with isoflorane and sevoflurane, respectively [6]. In the present study, extubation time was longer than that study. The reason of rapid recovery time could be associated with painful effects of orthopaedic surgery in the study of Mohamadnia et al. (2008). Recovery times were shorter in sevoflurane group than isoflurane group. It is concluded that sevoflurane could be considered as the first choice drug because of its short recovery time.

In conclusion, 18.23 mg/kg mean dose of thiopental administration is safe for induction of anaesthesia in goats. Sevoflurane and isoflurane are both suitable anaesthetics for the maintenance of general anaesthesia in Angora goats undergoing ovariectomy. The results of the study showed that there are no significant differences between sevoflurane and isoflurane for cardiovascular parameters. The recovery time from anaesthesia with sevoflurane is shorter than isoflurane although the difference is not statistically significant. Sevoflurane could be considered having advantageous to isoflurane because of the rapid recovery times.

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