IRANIAN JOURNAL OF
VETERINARY SURGERY
(IJVS)
WWW.IVSA.IR

Comparison of the Use of Mask or Chamber in Inducing Anesthesia with Isoflurane in Rabbits

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Abstract

Objective- To study the effects of Isoflurane in inducing anesthesia and comparing mask and chamber induction anesthesia in rabbits for the first trial in Iran.
Design- Experimental design.
Animals- 20 female adult New Zealand White rabbits.
Procedures- Animals were divided randomly into two groups. A 40 cm3 Chamber was used in group A with 4-5% concentration of isoflurane and a face mask was used in group B with 1-1.5% concentration of isoflurane to induce anesthesia. The concentration of isoflurane increased in 30 second intervals since reached to 4%. Routine ovariohysterectomy was performed in both groups. Duration of induction and recovery, apneuastic period and volume of consumed isoflurane were measured in both groups.
Results- Mean duration of induction of anesthesia was significantly shorter in group B in comparison to group A ($P<0.05$). Apneuastic duration was lasting 10 to 90 sec. The volume of isoflurane delivered to animals was significantly lower in group B (7.1±1.2 ml) compared with group A (24.7±6.6 ml) ($P<0.05$). The mean duration of recovery was not significantly different in group A compared to group B ($P>0.05$).
Conclusion and Clinical Relevance- As concluded use of isoflurane to induce anesthesia in rabbits is feasible and safe in case of available equipments. Mask induction seems more appropriate to induce anesthesia than chamber.
Key Words- Isoflurane, Inhalation Anesthesia, Chamber, Mask, Rabbit.

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Introduction

Inhalation anesthesia is frequently used in human and variety of wild and domestic animal species like reptiles, birds and rodents. Isoflurane introduced in 1981 is the most commonly administered volatile anesthetic today.[1] Although isoflurane is available commercially it is not widely used in Iran despite its advantageous properties over halothane the most famous and frequently anesthetic gas used in clinics. Isoflurane, halogenated ether, is a highly stable, non-explosive, potent volatile anesthetic with low solubility in blood. This means anesthetic concentration can be achieved very rapidly, so that it decreases the time needed for inducing anesthesia provides easier controlling depth of anesthesia. In addition, the rapid recoveries seen with isoflurane may be an advantage for outpatient surgeries.[2] Induction of anesthesia by a gaseous agent can be achieved by the use of rapid-acting inhalation anesthetics such as halothane or isoflurane. The application of inhalation anesthetics is generally considered to be much safer than injection anesthesia, due to the ability to better control the quantity of anesthetic applied.[3,4] The gas anesthetic contained in an anesthetic machine is administered to an alert patient through mask or chamber.[5] There are many reports of using isoflurane to induce or maintain anesthesia and several studies have been conducted to evaluate chemical and pharmacological properties of isoflurane.[6,7,8] But to the authors' knowledge there were no reports of use of isoflurane to induce anesthesia in rabbit in Iran. Because animals can breathe isoflurane without holding breath and coughing it can be used to induce anesthesia by mask or chamber.[6] Although there have been few clinical trials comparing its use to halothane and methoxyflurane, the pharmacology of the agent suggests certain situations in which it may be the preferable agent.[2]
The objective of this experimental design was to study effects of isoflurane in inducing anesthesia and comparing mask and chamber induction anesthesia in rabbits for the first trial in Iran.

Materials and Methods

20 adult healthy female New Zealand white rabbits, weighting 3.5± 0.4 kg, maintained in the same condition were divided into two groups randomly after approval was received by the University Research Committee. In group A, rabbits were placed inside a 40 cm^3 homemade chamber designed by the authors and then isoflurane was provided through the Y piece tube of the anesthetic machine attached to the inlet of the chamber (fig 1). Animals were preoxygenated for 1 minute for 1.5 l/min. Then a 4.0-5.0% concentration of isoflurane was delivered to the animals. They were observed carefully and as soon as they lost their ability to stand and lied down in the chamber. They were removed from the chamber and immediately attached to the anesthetic machine via mask. Next routine ovariohysterectomy was performed through ventral midline incision in all rabbits. In group B, a plastic face mask designed by the authors, was used to induce anesthesia by isoflurane using concentration of 1.0-1.5% (fig 2).
Every 30 seconds the concentration of isoflurane was increased to reach 4.0%. After the animals started to lose their consciousness and fully anesthetized the concentration was reduced to 1.5% for maintenance. When the animals were sufficiently anesthetized the flow rate was maintained 3.0-3.5 l/min during the operation. Then ovariohysterectomy procedure was performed in the same manner as group A. Once the surgery was completed the vaporizer was turned off and

isoflurane administration was discontinued. Oxygen was continued to be delivered to the animals. All animals were maintained and treat in the same manner.
Induction time of anesthesia and recovery along with duration of apnea and volume of delivered gas used for induction were recorded in all animals in both groups. They were monitored intensively for any signs of complications during induction of anesthesia, operation and recovery were recorded.

Figure 1. 40 cm^3 homemade chamber designed by the authors for isoflurane anesthesia.

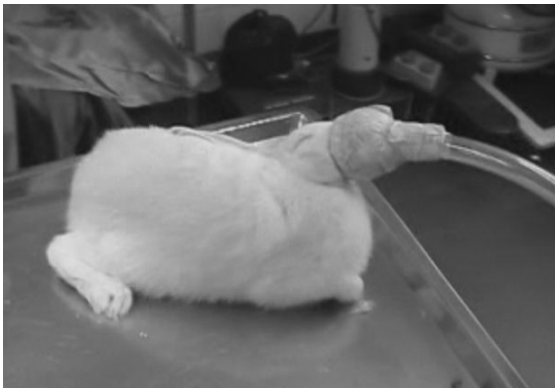

Figure 2. The plastic face mask is applied on the muzzle of the animal.

Mean of the measured variables were compared among groups using between-groups analysis of variances (ANOVA). Then Banferroni test was performed for pair wise comparison of means between groups. The P values less than 0.05 were considered statistically significant.

Results

All animals survived the surgery and recovered from anesthesia without any complication. The mean Duration of induction of anesthesia was 280±52.0 sec in group A and 130±35.0 sec in group B. The mean duration of recovery was 15.0±4 sec in group A and 13.0±7 sec in group B. Statistical analysis indicated that there was a significant difference between means of duration of induction anesthesia in both groups ($P<0.05$). Mean induction time of anesthesia was significantly shorter in group B in comparison to group A. However data analysis showed no significant difference in means recovery time in both groups ($P>0.05$). The results showed that there was a significant difference between means of volume of delivered isoflurane to induce anesthesia ($P< 0.05$). The volume was significantly lower in group B (7.1±1.2 ml) compared with group A (24.7±6.6 ml). All rabbits experienced duration of apnea which was more evident in group A than group B. Apneastic duration was widely variable among patients lasting 10 to 90 sec. There is no significant difference among mean duration of apnea in both groups ($P>0.05$).

Discussion

Inhalation anesthesia is the first choice for any major surgeries since rabbits are very fragile and high risk anesthetic patients.[9] Low blood soluble property of isoflurane leads to rapid absorption and distribution of isoflurane resulting in relatively rapid induction of anesthesia and smooth recovery. This makes isoflurane appropriate in induction of anesthesia in many species of

animals especially to those whom intubation is difficult and more prone to laryngospasm like rodents.[10] Reports are available for use of isoflurane in variety of species such as mammals, ornamental birds, reptiles and rodents.[3,9] Isoflurane was used safely in rabbits in this study which is in agreement with previously mentioned reports. Desflurane reported to be more suitable than isoflurane because of less physical or deleterious behavior. Also the induction time of anesthesia is shorter with isoflurane.[11] Isoflurane reported to have advantageous properties like higher MAC and less cardiovascular toxicity compared to halothane in rabbits.[12]

There are controversies for preferred method of induction of anesthesia by volatile agents. Mask induction can lead to handling stress whereas use of chambers causes more dead space than face masks.[8,13] Monitoring the patient during induction of anesthesia is possible with mask while not when using chambers.[5] The induction time of anesthesia was significantly lower when mask was used in group B. Flecknell in 1996 compared face mask and chambers in inducing anesthesia in rabbits reported the same result for chambers.[14] It is recommended that the mask should be tightly fit to the rabbits' muzzle to decrease the hazard of gas escape.[5] The mask used in the study was designed to fit tightly with the model animals' mouth. Since isoflurane is very insoluble, provides a very rapid recovery, so that no significant difference should be expected in duration of recovery whether using mask or chambers. Because chamber needs to be saturated until reached to the anesthesia concentration for the patient more gas needs to be delivered. This increased the induction time of anesthesia and the volume of isoflurane consumed for an individual patient as well. The chamber needs to be large enough for the patient to be relaxed with the neck extended.[6] There are commercially available chambers in different range of sizes. Smaller chambers seems more appropriate for rabbits than the 40 cm^3 –chamber used in this study- which can lower the risk of exposure of hospital personnel to waste anesthetic gas considerably. Apnea is common during induction of anesthesia with volatile agents which is the result of anesthetics' odour and irritation of respiratory mucus membranes. Different reports are available for duration of apnea which leads to significant bradycardia, hypoxia, hypercapnia and subsequent acidosis[11,14] The duration of apnea was higher in chamber induction which is because of more dead space of chambers and better restraint of the patient while face masks are used. This is in agreement with our finding. Also the mask presents the advantage that it can be removed quickly and be placed as soon as the animal starts breathing. So that apnea might be decreased in this way.[15] Use of premedication with sedative drugs such as midazolam or butarphanol will diminish the apneuastic duration.[16] To the authors' view preparing the face mask is more cost benefit than chambers and because patient can be monitored during induction mask is superior to chambers. Inhalation anesthesia with rapid-acting anesthetics like isoflurane is preferred over injecting anesthesia in rabbits and it is strongly recommended by many authors.[11,14,15] The peresent study confirmed the ease and feasibility of performing induction of anesthesia with isofularne. It is concluded that induction of anesthesia with a rapid acting inhalation agent- isoflurane- is safe. Isoflurane provides sufficient depth of anesthesia for performing surgeries. In addition face masks are preferred over chambers because of shorter time to induce anesthesia and less volume of consumed inhalation anesthetics.

Acknowledgment

The authors would like to sincere thank to Research Council of the Faculty of Veterinary Medicine and University of Tehran and Center of Excellence for Veterinary Research on Indigenous Domestic Animals for approval and assistance to complete this experimental trial. We also would like to appreciate Research Committee of Islamic Azad University, Garmsar branch.

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چکیده

مقایسه القای بیهوشی به صورت تجربی با داروی ایزوفلوران در دو روش قفس و ماسک در خرگوش

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هدف- مطالعه آثار القای بیهوشی با ایزوفلوران و مقایسه القای آن با قفس و ماسک در خرگوش.
طرح مطالعه- مدل تجربی.
حیوانات- ۲۰ خرگوش ماده و بالغ از نژاد سفید نیوزلندی.
روش کار- خرگوشها بصورت تصادفی به دو گروه مساوی تقسیم شدند. برای القای بیهوشی در گروه A اتاقکی به اندازه ۴۰سانتی متر مکعب طراحی گردید و از غلظت ۴ تا ۵ درصد ایزوفلوران جهت القا استفاده شد. در گروه B از غلظت ۱-۱.۵ درصد ایزوفلوران با استفاده از ماسک القای بیهوشی انجام شد و غلظت آن به صورت تدریجی به فواصل ۳۰ ثانیه ای افزایش یافت تا غلظت ۴ درصد حاصل گردد. جراحی اوریوهیسترکتومی به روش معمول در هر دو گروه انجام شد. مدت زمان لازم جهت القا و بازگشت از بیهوشی، طول دوره آپنوستیک و میزان ایزوفلوران مصرفی در هر دو گروه اندازه گیری شد.
نتایج- مدت زمان لازم جهت القای بیهوشی به صورت معنی داری در گروه B کوتاهتر از گروه A بود ($P<0.05$). طول دوره آپنوستیک از ۱۰ ثانیه تا ۹۰ ثانیه متغیر بود. میزان ایزوفلوران مصرفی در گروه B (7.1 ± 1.2) میلی لیتر بود که به صورت معنی داری از گروه A (24.7 ± 6.6) کمتر بود($P<0.05$). مدت زمان بازگشت از بیهوشی در هر دو گروه فاقد اختلاف معنی دار بود ($P>0.05$).
نتیجه گیری و کاربرد بالینی- القای بیهوشی با داروی ایزوفلوران در خرگوش ها در صورت فراهم بودن تجهیزات و امکانات مربوطه قابل انجام و مطمئن می باشد. به علاوه القای بیهوشی به کمک داروی ایزوفلوران با استفاده از ماسک مناسبتر از کاربرد قفس می باشد.
کلید واژگان- ایزوفلوران، بیهوشی استنشاقی، قفس، ماسک، خرگوش.