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Inhalational induction with isoflurane: the influence of lidocaine pretreatment

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Abstract: The effect of intravenous lidocaine in reducing the incidence of complicated induction during a single vital capacity breath technique using isoflurane was studied. Forty patients were randomized into two groups to receive either placebo (group A) or intravenous lidocaine 1.5 mg·kg^{-1} (group B) just prior to induction. Inhalational induction using 2% isoflurane and 66% nitrous oxide in oxygen was then carried out. Patients pretreated with lidocaine had significantly fewer complications during induction of anesthesia. Modest decreases in blood pressure and heart rate were observed in both groups but were clinically insignificant. Intravenous lidocaine pretreatment significantly reduced the incidence of complications during inhalational induction.

Key words: Induction, Isoflurane, Lignocaine

Introduction

Inhalational induction of anesthesia with a single vital capacity breath technique using halothane or isoflurane has been previously described [1,2]. Isoflurane should result in faster induction of anesthesia than halothane because of its lower blood-gas partition coefficient. However, its pungent odor is more irritating to the airways, resulting in a higher incidence of "complicated" induction [3]. Intravenous lidocaine has been used to suppress airway reflexes during induction and tracheal intubation [4]. This study was designed to investigate if the use of intravenous lidocaine could limit airway irritation associated with inhalational induction with isoflurane.

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Methods

After obtaining the approval of our Institutional Ethics Committee and informed patient consent, we studied 40 ASA physical status I unpremedicated adults aged 17–56 years presenting for elective operations. The patients were allocated randomly into two groups: in group A patients, anesthesia was induced with 2% isoflurane, 66% nitrous oxide in oxygen, while group B patients received intravenous lignocaine before gaseous induction with the same mixture. During the preoperative visits, the induction technique was explained and the patients were coached on the technique of taking a vital capacity breath (maximum inspiration from residual volume) and then holding the breath for as long as possible before resuming normal ventilation.

Fresh gas flow comprising 4 l nitrous oxide and 2 l oxygen with 2% isoflurane was used to prime the circuit of a circle system for 5 min. A 2-l bag was added to the inspiratory limb to increase the capacity of the circuit. The concentration of isoflurane was monitored from the elbow connector with the mask with a gas analyzer (Ultima, Datex, Helsinki, Finland).

Three minutes prior to induction, intravenous fentanyl 2 μg·kg^{-1} body weight was given to all patients. In addition, each patient in group B received 1.5 mg·kg^{-1} body weight of lidocaine while those in group A received normal saline. Each patient then exhaled to residual volume before taking a maximum inspiration from the primed system via a tight-fitting face mask at a rate such that the reservoir bag did not collapse completely. Patients were instructed and reminded every 10 s to keep their eyes open. Normal spontaneous respiration resumed when the patient was no longer able to sustain breath-holding comfortably. Loss of consciousness was defined as the failure to respond to verbal commands. Induction time was defined as the time between the beginning of the vital capacity breath and the loss of consciousness.

Monitoring consisted of continuous electrocardiogram, pulse oximeter, and automatic noninvasive blood pressure. Measurements were taken before administration of any drugs and at 1-min intervals thereafter.

An assistant, blinded to the drugs used during induction, recorded the changes in hemodynamics, induction time, and the total number of breaths required for induction. We defined an induction as "complicated" if the patient developed one or more of the following during induction: cough, breath-holding, excessive secretions, laryngospasm, or excitatory movements [5].

The data were analyzed using Student's *t*-test and Fisher's exact test as appropriate. All results are expressed as mean ± SD. A P value of <0.05 was taken as statistically significant.

Results

Patients in both groups were comparable with respect to age and body weight (Table 1). Anesthesia was successfully induced in 18 of the 20 patients in group A and all 20 patients in group B. Two inductions in group A were abandoned because the patients displayed severe coughing.

The mean time required for induction was not significantly different between the two groups ($P = 0.28$, Student's *t*-test, Table 2). The mean number of breaths taken for induction was also similar ($P = 0.34$, *t*-test). There were significantly more complicated inductions in group A compared with group B ($P < 0.05$, Fisher's exact test). During the study, coughing was observed in three patients in group A, two of which cases were so severe that induction using the inhalational technique had to be abandoned. Breath-holding was observed in two patients in group A and one patient in group B. Excitatory movements of the limbs occurred in two patients in group A.

In both groups, cardiovascular changes were similar, with a gradual decrease in the mean arterial pressure, but remained within clinically acceptable limits. The patients in group A showed a statistically significant decrease in mean blood pressure and heart rate at 2 and 3 min after induction, and at 1, 2, and 3 min in group B as compared to baseline (Table 3). There were no episodes of desaturation (SpO_2 <95%) in either group.

Table 1. Demographic data

	Group A $n = 20$	Group B $n = 20$
Age (yrs)	29 ± 13.5	27.4 ± 8
Sex (male/female)	12/8	14/6
Weight (kg)	58.8 ± 11.3	62.6 ± 11

Results expressed as mean ± SD.

Table 2. Induction characteristics

	Group A	Group B
Induction time (s)	141.6 ± 14	127.5 ± 32
No. of breaths taken to induction	4.4 ± 1.4	4 ± 1.1
Uncomplicated inductions	13	19
Complicated inductions	7*	1*
Cough	1	nil
Breath-holding	2	1
Excessive movements	2	nil
Abandoned	2	nil

Results expressed as mean ± SD.
*$P < 0.05$, Fisher's exact test.

Discussion

Rapid inhalational induction of anesthesia with a vital capacity breath was first described by Ruffle using halothane in volunteers [1]. He found this technique to be effective, safe, and generally well accepted in his subjects. However, the role of halothane in current practice has diminished due to its potential for hepatoxicity with repeated use. Lamberty and Wilson assessed the suitability of isoflurane as an alternative to halothane and found that it was surprisingly acceptable to patients despite its pungent odor [5]. However, 50% of the patients in their control group had some complications during induction, this incidence being significantly lowered by using a single vital capacity breath for induction. The single-breath technique has repeatedly been shown to reduce the incidence of complications during induction [5–8]. Other efforts advocated to minimize these airway complications include premedication with opioids [2] and benzodiazepines [9] as well as the use of humidified inspired gases [10]. Premedication may, however, modify the breath-holding time and delay the resumption of regular breathing as a result of the respiratory-depressant effects of these drugs.

Consistent with other studies, we found that inhalational induction with isoflurane using the single vital capacity breath technique is tolerated by most patients. Out of the 40 patients studied, 38 (95%) were successfully anesthesized by this technique. The 35% incidence of complications in the control group was comparable to other studies utilizing similar types and concentrations of anesthetic agents [5,11]. Pretreatment with intravenous lidocaine 1.5 $mg \cdot kg^{-1}$ significantly reduced the incidence of complications with minimal hemodynamic changes. Relative cardiovascular stability was noted in

Table 3. Comparison of cardiovascular stability between the two groups

	Before induction control	After induction (min) 1	2	3
Group A				
Mean blood pressure (mmHg)	97 ± 10	91 ± 14	86 ± 13*	84 ± 13*
Heart rate (beats·min^{-1})	78 ± 14	74 ± 18	68 ± 11*	67 ± 12*
Group B				
Mean blood pressure (mmHg)	92 ± 10	84 ± 9*	83 ± 13*	82 ± 13*
Heart rate (beats·min^{-1})	77 ± 15	67 ± 14*	66 ± 12*	66 ± 12*

Values are expressed as mena ± SD.
Differs from control; $P < 0.05$ (t-test).

our study as well as in other studies despite the high initial concentrations of the volatile agent and the mild increase in intrathoracic pressure induced by the Valsalva maneuver that was observed during the breath-holding period. The mild decrease in heart rate and blood pressure in both groups of patients, although statistically significant, is of doubtful clinical significance and did not cause any clinical problems.

The dose of lidocaine of 1.5 mg·kg^{-1} used in this study was based on other studies that had investigated the efficacy of lidocaine as a suppressant of respiratory reflex responses. Lidocaine has been shown to suppress both mechanically and chemically induced airway reflexes in anesthesized patients and volunteers [12–15]. Although the mechanisms by which intravenous lidocaine suppresses airway reflexes are unknown, a depressant effect on the central nervous system may be involved. A dose-related decrease in volatile agent requirement has been demonstrated, making it likely that the mechanism of action may also be related to an increase in the depth of anesthesia. Lidocaine could also increase the neuroexcitatory threshold in the reflex arc that is activated during airway irritation by inhalation of volatile agents [16–19].

Inhalational induction has a number of indications in adult patients. These include the induction of anesthesia in patients for day-care surgery in whom a rapid recovery—free from the hangover effect of intravenous agents—is preferred, in those where use of the intravenous agent is contraindicated, and most importantly, when a difficult airway is anticipated. Sevoflurane is the current volatile agent of choice for inhalational induction with its low irritability to the airways [19], ease, and speed of induction [20]. However, the availability of this agent is still limited due to its cost. As such, the more commonly available agents like halothane and isoflurane will continue to be used for inhalational induction when indicated. We have demonstrated that pretreatment with intravenous lidocaine may have some beneficial effect in reducing the incidence of airway complications during such an induction technique.

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