Propofol or sevoflurane for laryngeal mask airway insertion

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Purpose: Sevoflurane is a volatile anesthetic agent, which combines rapid, smooth inhalational induction of anesthesia with rapid recovery, making it particularly suitable for day case anesthesia. The laryngeal mask airway is often also used in ambulatory anesthesia, with intravenous propofol being the agent of choice for its insertion. Our objective was to compare the conditions for laryngeal mask airway (LMA) insertion obtained by modified vital capacity breath sevoflurane inhalational induction of anesthesia with propofol intravenous induction.

Methods: Eighty-eight patients, aged 18-65 yr, ASA I-II, undergoing general anesthesia for elective surgery were randomized into two groups in a prospective, single-blind study. Patients in Group P (n=44) received 2.5 $mg \cdot kg^{-1}$ propofol *iv* and in Group S (n=44) received sevoflurane 8% in nitrous oxide 50% and oxygen. Ventilation was not assisted. Laryngeal mask airway insertion was attempted at one minute intervals from loss of both verbal response and eyelash reflex, by an anesthesiologist unaware of the induction technique. Complications, such as coughing and head movement, were also noted at each attempt.

Results: Mean time to successful LMA insertion was 1.3 (1-3) min in P and 2.2 (1-3) min in S, $P < 0.05$. Eleven patients in Group P, (25%) required additional propofol compared with four (9%) in S, $P < 0.05$. Incidence of complications was similar in both groups and by 3 min, LMA was successfully inserted in all patients.

Conclusion: Modified vital capacity breath inhalational induction with sevoflurane 8% is efficient for LMA insertion in most cases, but takes slightly longer than propofol.

Objectif : Le sévoflurane est un anesthésique volatil qui permet à la fois une induction aisée de l'anesthésie par inhalation et une récupération rapide, ce qui le rend particulièrement approprié à la chirurgie d'un jour. Le masque laryngé est aussi souvent utilisé en anesthésie ambulatoire avec le propofol intraveineux comme agent de choix pour son insertion. Notre objectif était de comparer les conditions d'insertion du ML obtenues lors d'une induction modifiée de l'anesthésie par inhalation avec du sévoflurane, utilisant l'inspiration à capacité vitale, et lors d'une induction intraveineuse au propofol.

Méthode : Quatre-vingt-huit patients, âgés de 18-65 ans, ASA I-II, devant subir une anesthésie générale pour une chirurgie élective, ont été répartis au hasard en deux groupes d'étude prospective, à simple insu. Les patients du Groupe P (n = 44) ont reçu 2,5 $mg \cdot kg^{-1}$ de propofol *iv* et ceux du Groupe S (n = 44) du sévoflurane 8 % dans un mélange de protoxyde d'azote et d'oxygène à 50 %. La ventilation n'était pas assistée. Un anesthésiologiste ignorant la technique d'induction utilisée a tenté l'insertion du ML, à une minute d'intervalle de la perte de réponse verbale et du réflexe ciliaire. Les complications, comme la toux et les mouvements de la tête, ont été notées à chaque essai.

Résultats : Le temps moyen d'une insertion réussie du ML a été de 1,3 (1-3) min chez les patients du Groupe P et de 2,2 (1-3) min pour ceux du Groupe S, $P < 0,05$. Onze patients du Groupe P, (25 %) ont eu besoin de propofol supplémentaire, en comparaison de quatre (9 %) du Groupe S, $P < 0,05$. L'incidence des complications a été similaire dans les deux groupes et, chez tous les patients, l'insertion réussie du ML n'aura pas pris plus de trois minutes.

Conclusion : L'induction modifiée de l'anesthésie par inhalation avec du sévoflurane 8 %, utilisant l'inspiration à capacité vitale, est efficace pour l'insertion du ML dans la plupart des cas, mais la technique demande un peu plus de temps qu'avec l'utilisation du propofol.

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SATISFACTORY insertion of the laryngeal mask airway (LMA) after induction of anesthesia requires sufficient depth of anesthesia for suppression of airway reflexes. Propofol has been shown to be superior to thiopental when these agents are used alone for facilitating insertion of the LMA[1] and it has been recommended that propofol is the induction agent of choice for its insertion.[2] However, bolus intravenous propofol may cause prolonged apnea,[3] is more expensive than thiopental and often causes pain on injection.[4]

A number of studies using intravenous co-induction techniques have been undertaken, some demonstrating equivalent conditions to propofol when thiopental was combined with either topical lidocaine to the oropharynx[5] or 0.1 $mg \cdot kg^{-1}$ midazolam *iv*.[6] Other reports suggest that propofol remains superior to thiopental for LMA insertion when used in conjunction with midazolam and alfentanil.[7,8]

Sevoflurane is a halogenated, volatile anesthetic agent with a pleasant odour, non-pungency and low blood gas solubility. It allows rapid smooth inhalational induction with excellent recovery characteristics and is a suitable agent for use in ambulatory anesthesia. A high inspired concentration vital capacity breath induction technique provides good conditions for the insertion of the LMA.[9] The objective of this prospective, randomized, single-blind clinical trial was to compare sevoflurane vital capacity breath inhalational induction with conventional intravenous propofol induction, in terms of conditions for insertion of the LMA.

Methods

After institutional ethics committee approval and informed consent, 88 patients undergoing elective orthopedic, plastic or gynecological procedures where use of the LMA was indicated, were enrolled in the study. Both in-patients and day cases were included. Premedication and smoking habits were noted. All patients were ASA I or II, aged 18-65 yr. Patients were excluded if they were predicted to have a difficult airway (Mallampatti Grade III or IV), had a history of gastrointestinal reflux, were scheduled for emergency surgery, were receiving anti-epileptic medication, had a history of cardiovascular, hypertensive or renal disease, pregnancy, or known allergies to any anesthetic agent.

After intravenous access was established and a slow infusion of crystalloid commenced, monitoring was instituted, which consisted of electrocardiography, non-invasive blood pressure measurement at three minute intervals and continuous pulse oximetry. Prior to induction, all patients inspired oxygen 100% at 8 $L \cdot min^{-1}$ through a transparent facemask attached to a Bain (Mapelson D) circuit with a two litre reservoir bag for one minute. No opioids or benzodiazepines were given.

Patients were randomized into one of two groups for induction of anesthesia :- Group P received induction with 2.5 $mg \cdot kg^{-1}$ propofol *iv* over 30 sec. Lidocaine 1%, 2 ml, was mixed with each 20 ml syringe of propofol. Group S had inhalational induction with sevoflurane 8% in nitrous oxide 50% and oxygen (flow rate of 8 $L \cdot min^{-1}$) having first primed the circuit as described below. The eyelash reflex of the patient was sought by continuously stroking the eyelashes after the patient had either spontaneously closed their eyes or immediately after loss of verbal contact. Verbal contact was maintained by asking the patient to count aloud. Size #3 LMA was used in women and #4 in men. Ventilation was not manually assisted.

In group P, LMA placement was attempted at one minute following induction of anesthesia (confirmed by loss of verbal contact and loss of eyelash reflex, time zero) for 15 sec. If unsuccessful, as defined by inadequate jaw relaxation to allow LMA passage into the mouth, spontaneous, assisted ventilation of N_2O 50% and O_2 was performed by facemask attached to a Bain circuit between each attempt. Additional propofol, 1-2 $mg \cdot kg^{-1}$, was given if unsuccessful after two minutes or if an adverse response (reflex head movement, cough, gagging, laryngospasm) occurred which did not settle spontaneously.

In group S, patients were pre-oxygenated as described above. Then, the Bain circuit reservoir bag was emptied, the adjustable pressure limiting valve closed and the patient end of the system sealed by pressing the outlet firmly against the pillow. The circuit was primed with sevoflurane 8% in N_2O 50% and O_2 at 8 $L \cdot min^{-1}$ for 30 sec. Each patient was asked to exhale maximally and the face mask, connected to the primed circuit, was placed over the mouth and nose. They were then encouraged to take vital capacity breaths and to continue doing so.

As in the propofol group, LMA insertion was attempted at one minute intervals from time zero (defined as time of loss of both verbal response and eyelash reflex), for a duration of 15 sec. If an attempt was unsuccessful (defined by inadequate jaw relaxation for passage of the LMA or occurrence of an adverse event such as severe coughing, gagging or laryngospasm), patients in the sevoflurane group were allowed to continue spontaneous, assisted ventilation on sevoflurane 8% in N_2O 50% and O_2. The second and third attempts were then made at 2 min 15 sec and 3 min 30 sec after commencement of induction. Additional propofol was given if an adverse response

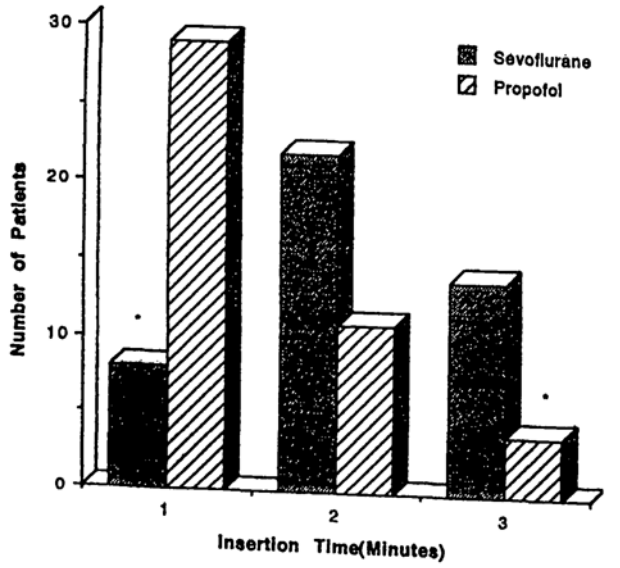

FIGURE Time to Successful LMA Insertion
*P<0.05

occurred in either group. The response of the patient to LMA insertion was noted including the presence or absence of gagging, coughing, jaw relaxation, limb and head movement, or laryngospasm. The time to apnea and to successful LMA placement were noted.

The anesthesiologists who placed the LMA were unaware of the induction technique used in each case. They stayed outside the anesthetic room during the initial induction period and at one minute intervals were called into the room to attempt placement of the LMA. If the first attempt was unsuccessful after 15 sec, they left the room. This anesthesiologist was recalled one minute later to repeat the attempt for 15 sec. This procedure was repeated until the LMA was successfully positioned. The anesthesiologist responsible for induction and maintaining the airway controlled the time of LMA insertion attempts, using the induction-room wall clock. Since both groups of patients had a facemask placed over their face, were breathing spontaneously during the interval between each attempt, and the intravenous access and the vaporizers were obscured from view, the anesthesiologist attempting LMA insertion was unaware of the induction technique. The two anesthesiologists who enrolled the patients (MEM and DJB) were senior residents of four and five years of clinical experience, respectively.

Statistical analysis involved Student's unpaired t test for continuous (demographic) data and Chi-squared or Fisher Exact test for categorical data. The 5% level

TABLE I Demographic and Clinical History Data.

	Propofol (n=44)	*Sevoflurane (n=44)*
Age (yr) mean (range)	27 (18-61)	29 (18-65)
Male/Female	26/18	22/22
Weight (kg) mean (SEM)	61.2 (9.9)	59.9 (12.3)
Smokers (n)	17	19
Received Premedication (n)	10	8

TABLE II Additional Features of LMA Insertion.

	Propofol (n=44)	*Sevoflurane (n=44)*	*P*
Time to LMA insertion (min), mean (range)	1.3 (1-3)	2.2 (1-3)	< 0.05
Additional propofol n (%)	11 (25%)	4 (9%)	< 0.05
SpO_2 (median, range)	96%(94-100)	99%(96-100)	NS
Apnea Duration (sec), mean (range)	35 (10-60)	25 (0-45)	< 0.05

TABLE III Occurrence of Adverse Events During Attempted LMA Placement.

	Propofol	*Sevoflurane*
Head movement (n)	12	12
Limb movement (n)	16	18
Gag (n)	9	10
Cough (n)	6	5
Laryngospasm (n)	5	5

P: NS.

of probability ($P < 0.05$) was taken as significant. Taking a 30% difference in the proportion of patients with successful LMA placement as being clinically important, we calculated that 40 patients would be required in each group for a Type II error of 0.2 i.e. with power of 80%, to detect a true difference between the groups.

Results

Eighty-eight patients were enrolled in this study, 44 in each group. There were no differences between the groups with respect to demographic data or premedication and smoking habits (Table I).

The mean time to loss of consciousness was 44 (25-70) sec in propofol group compared with 25 (15-50) sec in patients receiving sevoflurane, median (range), $P < 0.05$. The median (range) time to successful insertion of LMA in the propofol group was 1.3 (1-3) min compared with 2.2 (1-3) min in the sevoflurane

group, $P < 0.05$, Figure. In P, 11 (25%) patients required additional propofol (1 $mg \cdot kg^{-1}$) for successful insertion, compared with 4 (9%) in group S, $P < 0.05$. All patients had LMA successfully positioned by three minutes. The duration of apnea was longer in the P than the S group 35 (range 10-60) *vs* 25 (range 0-45) sec, $P < 0.05$, respectively (Table II). The incidence of adverse events occurring during attempted insertion of the LMA is shown in Table III. Muscle relaxants were not required on any occasion in the patients studied.

Discussion

This study has shown that vital capacity breath inhalational anesthesia with sevoflurane provided good conditions for LMA insertion, comparable to intravenous propofol induction, but required a longer induction time to do so. This is the first study to compare intravenous propofol given alone (mixed with lidocaine 1% to reduce pain) with vital capacity sevoflurane 8% inhalational induction in terms of the conditions provided and time required for successful LMA insertion. Thwaites *et al.*, in a randomized double-blind comparison of induction characteristics of sevoflurane and propofol, found slower induction of anesthesia with tidal volume sevoflurane induction than with propofol. Transition to maintenance anesthesia was reported as being smoother with sevoflurane, but facemask anesthesia for short cystoscopy cases was used in this study.[12]

Previous studies have given manually assisted ventilation for two minutes or more, or used opioids or other co-induction agents.[1,5-8,13] The vital capacity breath inhalational technique with sevoflurane is associated with less airway complications than tidal breathing techniques.[9] It also provides good conditions for LMA insertion, especially when used with nitrous oxide 50% in oxygen.[9,10] However, a large proportion of patients in both groups exhibited some adverse airway event. This reflects the fact that most of these events occurred during the first attempted LMA placement at one minute, the frequency diminishing after two minutes. We felt it was necessary to attempt placement at one minute intervals to estimate the time to successful insertion accurately, although in practical terms we were aware that few patients would be ready after the first minute. Indeed, it is possible that our choice of one-minute intervals for LMA placement attempts may have overestimated the time to successful instrumentation in either group, particularly those receiving sevoflurane, but it would have been impractical and possibly hazardous to patients to attempt it more frequently.

We used a modified vital capacity technique with sevoflurane as described above because we felt this facilitated better patient co-operation and faster induction time. Propofol was used as a "rescue" agent in the event of an adverse response in either group, because its rapid onset would quickly and reliably deepen the level of anesthesia and also because it is seen as the "gold standard" for creating favourable conditions for LMA insertion. The fact that more patients in whom anesthesia was induced initially with propofol warranted further doses of propofol than when initial induction was with sevoflurane is a finding that demonstrates the quality of conditions for LMA placement given by sevoflurane. However, the additional boluses given to propofol-induced patients may have improved the conditions for LMA placement in this group subsequently.

In contrast to our data, Muzi *et al.* required only 1.7 (0.7-2.7, 95% CI) min to position the LMA successfully following vital capacity breath inhalational induction with sevoflurane.[11] This may reflect the fact that these investigators manually ventilated their patients' lungs until satisfactory conditions were reached. However, Hall *et al.* showed that the time (mean ± SD) to jaw relaxation was 146 ± 66 sec and settled breathing after insertion of LMA was 173 ± 76 sec after single breath vital capacity induction with sevoflurane 8% in N_2O and O_2.[10] Our finding of a median time to LMA insertion of 2.2 min compares favourably with their studies.

We noted transient apnea in some patients during induction in both groups, more particularly in the propofol group. This was almost certainly due to mild hyperventilation associated with the vital capacity breath technique, possibly aggravated by pre-induction anxiety during the pre-oxygenation phase. We chose not to assist ventilation manually in this study if apnea occurred, as we believed it would remove a major benefit of the inhalational technique i.e. minimal interference with spontaneous ventilation.

Smoking had no effect on the adverse responses or the successful insertion of the LMA in our study, but the number of smokers that were included was small. Although the administration of 10-20mg temazepam *po*, one- two hours pre-induction could not be standardized because clinicians wanted to retain this option for anxious patients, the proportion of patients in each group receiving this premedication was similar and, hence, is unlikely to have biased the results. Retrospective analysis showed that receiving premedication did not affect the incidence of apnea.

The use of a four litre rather than a two litre reservoir bag is thought to accommodate the vital capacity breath technique, ensuring high concentrations of sevoflurane in a pre-filled system and allows lower flow

rates. However with regard to induction time, Hall *et al.*, using a four litre bag, found induction times comparable with those of Yurino and Kimura who used the smaller two litre reservoir bag.[9,10] A potential limitation of our present study is the possibility that the anesthetist inserting the LMA may have been inadvertently "unblinded" by the smell of sevoflurane during his repeated visits to the induction room. However, we did not feel that we could tell which induction method had been used. Although all patients were monitored as described, we did not document absolute arterial blood pressure values in this study. In a study comparing propofol with tidal volume sevoflurane induction, Thwaites *et al.* noted lower mean arterial pressure values in patients receiving propofol.[12]

In conclusion, we found that using this technique, high inspired concentration vital capacity breath inhalational induction sevoflurane is efficient for LMA insertion in most cases, but requires more time than with propofol.

References

1 *Scanlon P, Carey M, Power M, Kirby F.* Patient response to laryngeal mask insertion after induction of anaesthesia with propofol or thiopentone. Can J Anaesth 1993; 40: 816–8.

2 *Brain AIJ.* The Intavent Laryngeal Mask Instruction Manual, 2nd ed. 1991.

3 *Taylor MB, Grounds RM, Mulrooney PD, Morgan M.* Ventilatory effects of propofol during induction of anaesthesia. Comparison with thiopentone. Anaesthesia 1986; 41: 816–20.

4 *McCulloch MJ, Lees NW.* Assessment and modification of pain on induction with propofol (Diprivan). Anaesthesia 1985; 40: 1117–20.

5 *Seavell CR, Cook TM, Cox CM.* Topical lignocaine and thiopentone for the insertion of a laryngeal mask airway. Anaesthesia 1996; 51: 699–701.

6 *Driver IK, Wiltshire S, Mills P, Lillywhite N, Howard-Griffin R.* Midazolam co-induction and laryngeal mask insertion. Anaesthesia 1996; 51: 782–4.

7 *Bapat P, Joshi RN, Young E, Jago RH.* Comparison of propofol versus thiopentone with midazolam or lidocaine to facilitate laryngeal mask insertion. Can J Anaesth 1996; 43: 564–8.

8 *Driver I, Wilson C, Wiltshire S, Mills P, Howard-Griffin R.* Co-induction and laryngeal mask insertion. A comparison of thiopentone versus propofol. Anaesthesia 1997; 52: 698–700.

9 *Yurino M, Kimura H.* A comparison of vital capacity breath and tidal breathing techniques for induction of anaesthesia with high sevoflurane concentrations in nitrous oxide and oxygen. Anaesthesia 1995; 50: 308–11.

10 *Hall JE, Stewart JIM, Harmer M.* Single-breath inhalation induction of sevoflurane anaesthesia with or without nitrous oxide: a feasibility study in adults and comparison with an intravenous bolus of propofol. Anaesthesia 1997; 52: 410–5.

11 *Muzi M, Robinson BJ, Ebert TJ, O'Brien TJ.* Induction of anesthesia and tracheal intubation with sevoflurane in adults. Anesthesiology 1996; 85: 536–43.

12 *Thwaites A, Edmends S, Smith I.* Inhalation induction with sevoflurane: a double-blind comparison with propofol. Br J Anaesth 1997; 78: 356–61.

13 *Fahy LT, van Mourik GA, Utting JE.* A comparison of the induction characteristics of thiopentone and propofol (2, 6-di-isopropyl phenol). Anaesthesia 1985; 40: 939–44.